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Examination of Health Related Practices and Knowledge That May Affect Blood Pressure in NCAA Division 1 Collegiate Football Players

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EXAMINATION OF HEALTH RELATED PRACTICES AND KNOWLEDGE THAT MAY AFFECT BLOOD PRESSURE IN NCAA DIVISION 1 COLLEGIATE FOOTBALL PLAYERS

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ABSTRACT:

In order to determine blood pressure changes during the football season and the causes of the changes in collegiate football athletes, forty-seven National Collegiate Athletics Association (NCAA) division 1 athletes were recruited to participate in the study. Each participant had a pre-season, mid-season, and post-season blood pressure measurement taken. A questionnaire was completed at the mid- and post-season blood pressure assessments to determine blood pressure knowledge, dietary intake, and physical activity levels. An educational tool was provided in order to encourage knowledge growth regarding general blood pressure knowledge and causes of high blood pressure. Overall, blood pressure levels showed a decrease in both systolic (6.71 ± 12.3 mmHg) and diastolic (1.64 ± 8.71 mmHg) measures from the mid-season to post-season measurements. There were no notable changes in knowledge levels. Some significant positive changes were made in dietary intake, specifically in athletes eating more meals at home and fewer meals at the athletics' cafeteria, and a decrease in sweet snack intake. Other significant changes took place in physical activity levels, specifically an increase in resistance training. The information gained from the study can be used in the future to improve blood pressure management in elite level college athletes.

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CHAPTER ONE

INTRODUCTION:

Hypertension is one of the greatest health issues in the United States today and does not exclude the athletic population. One in three Americans have been diagnosed with hypertension, which is one of the leading causes of other cardiovascular disease along with kidney disease, stroke, and premature death.[6-9] Blood pressure rates are thought to be optimal if they are slightly less than120 mmHg for systolic blood pressure (SBP) and 80 mmHg diastolic blood pressure (DBP). Pre-hypertensive levels are in the range of 120-139 mmHg SBP and 80-89 mmHg DBP. Hypertensive levels are when the SBP is greater than 140 mmHg and the DBP is greater than 90 mmHg.[6] Each increase of 20 mmHg in SBP and 10 mmHg in DBP pressure, doubles the risk of cardiovascular disease along with mortality.[9] An increase in SBP of DBP is often due to a family history, sodium and potassium intake, alcohol consumption, and physical inactivity.[6]

Studies have shown that those participating in college athletics tend to also have an increased blood pressure, even with an elevated physical activity level. An “athlete’s heart” is defined to have characteristics of a high resting stroke volume and cardiac output, low peripheral resistance, low heart rate, and possibly a high systolic blood pressure.[5] American style football (ASF) is the most popular male sport amongst the youth and young adults in the United States.[3] In the National Collegiate Athletics Association (NCAA), 25 percent of all male athletes are football players.[4] Football athletes tend to have higher blood pressure rates, especially later in life.[9] The increase in blood pressure in football athletes often takes place within the first season of participation at the college level and fourteen percent of ASF athletes have been recorded as being diagnosed with hypertension.[4] When an athlete's systolic blood pressure becomes 160mmHg or greater, or if the diastolic blood pressure becomes greater than 100mmHg the athlete is likely to be withheld from participation.[1] Many ASF athletes partake in behaviors known to increase the risk of cardiovascular diseases such as specific training methods, diets, and weight gain goals.[2,9] The purpose of the study was to observe the blood pressure patterns of athletes involved in major division 1 collegiate football throughout a single season and test the effectiveness of an educational handout on knowledge in collegiate football athletes. The study objectives were to: compare the blood pressure knowledge, food intake patterns, and physical activity practices of collegiate football players pre- and post-educational intervention; compare blood pressure measurements of collegiate football players pre- and post-educational intervention; examine the relationships between the blood pressure measurement of collegiate football athletes and athletes' knowledge of risk factors for increased blood pressure. Three research questions were asked including: 1) How effective is a fact sheet educational intervention in resulting in improvement in blood pressure in elite collegiate football players? 2) How effective is a fact sheet educational intervention in increasing blood pressure knowledge of collegiate football players? 3) How effective is a fact sheet educational intervention in increasing collegiate football players knowledge of the causes of increases in blood pressure?

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CHAPTER TWO

LITERATURE REVIEW

Introduction:

Overview:

The purpose of the literature review was to assess the research on the topic of blood pressure in athletics, more specifically collegiate American-Style Football players. Articles reviewed were found through the search databases CINAHL, SPORTdiscus, and MEDLINE using the Clemson University online library. The keywords used in this search included “blood pressure”, “hypertension”, “high blood pressure”, and “athletics”. Amongst the articles the topics that were researched varied between those involving general populations, athletic populations, young adults, college students, collegiate athletes, and specifically football players. All studies with an association to hypertension were read and reviewed.

Hypertension is one of the most prevalent chronic diseases in the US, and is a risk factor for cardiovascular and kidney disease, stroke, and premature death if not treated properly.[25, 11, 27] The levels of blood pressure are defined as optimal (120/80 mmHg or less), pre-hypertensive (120-139 mmHg/80-90 mmHg), and hypertension (140/90 mmHg or greater) with blood pressure being the amount of pressure placed against the walls of blood vessels while the heart disperses blood throughout the body.[25, 15] Systolic blood pressure, noted as the first or “top” number of a blood pressure, is defined as the amount of pressure against the blood vessel’s walls when the heart has actively contracted. The diastolic blood pressure is the pressure on the arteries after the heart has completed its contraction and blood is not being actively forced through the blood vessel.[15] Diastolic blood pressure is represented as the second or "bottom" number of a blood pressure measurement and is typically lower than the systolic blood pressure.

Approximately one third of the adult population in the United States have been diagnosed with hypertension, doubling the risk of mortality as a result of cardiovascular disease along with kidney, nervous system, and eye damage.[33,13,21] A reduction in blood pressure is associated with an increase in brain health; with a decrease in the risk of dementia, diminishing cognitive function, along with cerebrovascular disease shown.[12] Hypertension has become prevalent within the renal transplant population, and often results in a loss of the transplant and fatality.[1] With the prevalence of hypertension being so great in the general population, the occurrence of the disease is also increasing in athletes.

HYPERTENSION IN ATHLETES

Athletes with a family history of hypertension are predisposed to high blood pressure and this diagnosis often begins in early adulthood. Studies have shown that 80 percent of adolescents between the ages of 11 and 13, whose blood pressure is within the pre-hypertensive range later develop hypertension in adulthood.[30] The most popular sport male adolescents in the United States participate in is American-style football (ASF), and as a result over a quarter of the athletes in the NCAA participate in football.[24,23] Studies have shown hypertension, concentric left ventricular hypertrophy, and premature cardiovascular mortality amongst professional football players.[33,17] The pathophysiological changes may be caused by particular behaviors that are often associated with higher level football athletes including intense resistance training and lack of aerobic exercise, diets that are high in fat and calorie dense, along with weight gain.[3,13] Another factor that may play a role in hypertension development is the characteristics of "an athlete's heart". Elite level athletes tend to have a high resting stroke volume and cardiac output, yet low peripheral resistance and heart rate. Due to the increased stroke volume and cardiac output, a high systolic blood pressure may be present.[14] Within the study "High Prevalence of Hypertension Among Collegiate Football Athletes" it was noted that football athletes showed an increase in blood pressure, with 14 percent of the individuals resulting in a hypertension diagnosis within a single season.[23] An increase of 20 mmHg in systolic blood pressure, along with a 10 mmHg rise in diastolic blood pressure drastically increases the risk of cardiovascular disease development, which is the highest cause of morbidity and mortality.[33,13]

FACTORS THAT AFFECT BLOOD PRESSURE

The cause of hypertension is often a combination of non-modifiable and modifiable factors including family history, race, diet, and physical activity levels but ultimately revolves around the cardiac output and peripheral vascular resistance of the individual.[5,15] Blood pressure is the product of the heart rate and the stroke volume of the heart. In the United States, African Americans are at an increased risk for developing hypertension and other cardiovascular diseases.[31] Blood pressure is a sensitive measurement and is affected by many different things throughout the day. A delicate aspect of the cardiovascular system that it is affected by anything that would change the heart pumping aspects, or affects the blood vessels.[6]

PHYSIOLOGICAL FACTORS

Physiological factors that play a significant role in the control of blood pressure are receptors in the aorta that help maintain blood pressure coming from the central nervous system. The receptors are referred to as baroreceptors and are controlled by the cerebrospinal and sympathetic nervous system.[15,6] The nervous system also is responsible for other factors that may affect one's blood pressure such as hormone secretion such as adrenaline, noradrenaline, the renin-angiotensin-aldosterone system, antidiuretic hormone and atrial natriuretic peptide.[15] Adrenaline's relationship to athletics is through its ability to increase muscle output (capacity) during times of stress.[2] Another one of the major indicators of vascular disease is the measurement of arterial stiffness and width.[17,21] The greater the increase in arterial stiffness, the greater the increase in risk for vascular disease, including hypertension.[17]

A common factor in hypertension is being overweight or obese. According to the Centers for Disease Control, obesity and overweight is defined as 'Weight that is higher than what is considered as a healthy weight for a given height.' Body Mass Index, or BMI, which is body weight (Kg)/height (m^2) is typically used as a screening tool for overweight or obesity. A BMI of 25.0 to 2.9 is considered to be overweight, while a BMI of 30 or greater is typically considered obese. However, it is important to note that the use of BMI is for screening purposes and has not been shown to be applicable in many athletes whose weight consists largely of increased lean muscle mass, rather than increased fat mass. Therefore, obesity can also be defined as a dramatic increase in body weight due to fat quantity, which is more applicable in athletic populations. Studies have shown that obese children and adolescents showed an exceptionally higher blood pressure measurement than those of normal weight. The World Health Organization (WHO) claims that with obesity there is an increase of two to six fold in the development of hypertension. They also state every 10 kg increase in weight results in an increase of 2-3 mmHg in SBP, along with an increase in 1-2 mmHg in DBP.[28]

ENVIRONMENTAL FACTORS

One cause of hypertension and other cardiovascular diseases that is often overlooked is the exposure to air pollution. When polluted air is introduced to the body through inhalation, the blood pressure rise may occur due to the autonomic nervous system. The increase in blood pressure can lead to cardiovascular disease and left ventricular hypertrophy. Both of the health concerns previously mentioned have been demonstrated to be influenced by long-term exposure to polluted air. Recent research has begun to propose short-term air pollution exposure may also lead to temporary blood pressure increases.[26] The research on the latter topic is currently limited and should be further investigated. In relation to air pollution exposure, an increase in particulate matter has demonstrated an increase in hypertension risk. One of the results of particulate matter in the body is oxidative stress. Oxidative stress occurs when the particles are inhaled and results in free radical formation, thus causing reactions in the lungs, heart, and other vascular tissues. The particles that commonly lead to free radical formation include chemicals, metals, soot, soil, dust, and allergens and largely depend on the source. The reactions of the particles may aid in vasoconstriction which can be a factor in hypertension.[31]

Another commonly overlooked factor that may cause hypertension is the intake of arsenic in drinking water in the United States. Millions of Americans are exposed to drinking water with arsenic above the World Health Association's standard. The exposure to the drinking water must be long-term to show an increase in blood pressure. Few studies have been performed on arsenic exposure and blood pressure, and there is room for further investigation.[22] If an area in which athletes are participating has high levels of arsenic in the water, this may cause an increase in the blood pressures of the individuals, which may not show improvements from standard treatments.

METHODS OF CONTROL

Controlling one's blood pressure when diagnosed with hypertension can occur through many different mechanisms. Although there is a great amount of research performed on the subject, adherence to one's hypertension treatment regimen which may result in treatment goals being reached tend to be relatively low reaching only fifty to seventy percent.[19] Hosseininasab et al.[19] reports the lack of consistency among patients can be attributed to negative reactions to drug therapy, forgetfulness, along with a lack of motivation due to no physical signs of high blood pressure. In order to combat issues, action has been taken by simplifying drug treatments educating the patient, creating support programs and reminder systems, and most recently at home self-monitoring systems implementation. Changes in adherence to blood pressure treatment may allow for individuals to learn the importance of blood pressure control, along with gaining attention to changes in the patient's blood pressure.[19] In another study, the individuals involved in the intervention were provided a one hour education course from a pharmacist and were then given instruments to measure their blood pressures at home.[12] The at home blood pressure measurement method resulted in improvement in blood pressure measurements amongst 450 adults in a Midwestern urban setting who had previously been diagnosed with hypertension.[12] The use of home blood pressure monitoring was also used in renal transplant patients that showed an association with improvements in blood pressure with the home blood pressure monitoring.[1] Another similar approach was taken through sending out health "report cards" to the individuals in the study, which proved beneficial.[34] The report cards included cholesterol and blood pressure measurements, diabetes indicators, smoking status, along with lifestyle factors of diet and physical activity. [34] The factors were used to calculate an overall cardiovascular disease risk score. [34]

DIET

Dietary measures that can be taken in order to decrease one's blood pressure include consuming a diet rich in fruits, vegetables, potassium, magnesium and calcium.[35] A decrease in sodium intake proves to be beneficial as well, with the recommendation by the National High Blood Pressure Education Program being less than 2300 mg daily.[35] A sodium intake of less than 1500mg has been shown to be beneficial for lowering blood pressure levels.[35] The Dietary Approaches to Stopping Hypertension (DASH) diet advises a diet rich in fruits, vegetables, and low fat dairy, nuts, whole grain, and poultry, while limiting saturated fat, cholesterol, and total fat.[35] The foods that are suggested stem from nutrients that are shown to be beneficial to lowering blood pressure, which were previously mentioned.[35] Research has shown an increase in blood pressure is correlated with carbohydrate and fat intake, while protein and calcium intake was associated with a decrease in blood pressure.[28]

PHYSICAL ACTIVITY

Regular physical activity should be added into a daily routine as well.[21] Regular physical activity has been shown to be beneficial in the treatment of hypertension. Much scientific research has been performed on the effects of physical activity on blood pressure. Routine moderate-intensity physical activity including resistance training proved to decrease blood pressure in those with and without hypertension.[10] Aerobic training specifically has been shown to decrease active and resting blood pressure rates. Blood pressure monitoring during sleep has shown for any amount of physical activity performed throughout the day, a decrease in blood pressure at rest came about.[16] Endurance training specifically has shown to induce vasodilation, increasing the width of the vascular system and thus lowering blood pressure. The type of exercise along with the duration and intensity play a key role in the physiologic effects produced.[29]

MEDICATIONS

The medications often involved in the treatment of hypertension include diuretics, which decrease water and sodium content in the body through excretion.[21] The heart then does not have to work as hard to pump blood throughout the body.[21] Other common medications that may be prescribed to lower the arterial resistance include vasodilators and ACE inhibitors.[21] Calcium channel and beta blockers are other medications used for the control of hypertension which act by aiding in the relaxation of blood vessels and decreasing heart rate, respectively.[19] Antioxidants which include vitamins A, C, E, and selenium, may be used as hypertension treatments as well, specifically if one of the causes of development is from air pollution.[31] The necessary vitamins and minerals can be obtained in the diet through an increased intake in fruits, vegetables, and whole grains.[31]

MEASUREMENT TECHNIQUES

Blood pressure measurements may be taken through many different methods and is very common practice in health care. The most common methods used are peripheral blood pressures taken through many different processes including the use of a mercury, aneroid, and automated blood pressure cuff, along with ambulatory blood pressure measurement.[15] There is also greater error involved with the simpler blood pressure measurement, thus making the information gathered more likely to be inaccurate. In order to decrease the risk of error in the blood pressure measurement process, measuring devices must be properly maintained, certified and recalibrated in order to maintain accuracy. If a blood pressure measurement reads lower than the actual blood pressure of the individual, the individual is more susceptible to cardiovascular health issues due to a lack of diagnosis when necessary. Yet if ones measurement reads higher than the actual blood pressure of the participant, then an improper diagnosis may be made and needless intervention may be implemented.

An individual’s blood pressure varies throughout the day. In order for a diagnosis of hypertension to be made, measurements must be taken multiple times with a standardized procedure.[21] When blood pressure measurements are being taken, there are some factors that should be taken into consideration such as: current emotional status, exercise factors, smoking, alcohol consumption, temperature, respiration, digestion, bladder distention, and current pain levels. An additional factor that may result in a significant effect on the blood pressure reading is the psychological effect of the individual getting their blood pressure taken. The psychological effect has been shown to result in an increase in systolic blood pressure up to 20 mmHg. Other uncontrollable (non-modifiable) factors that may require attention are the individual’s race or age. Fitness levels may have a profound effect on blood pressure status.

PATIENT POSITION

In order to obtain a proper blood pressure measurement there is a specific operation that should take place to reduce inaccuracies. With peripheral blood pressure measurements, several aspects of the process should be considered. Conditions include the patient, blood pressure cuff, and arm position. The recommended method for blood pressure measurement states the individual should be seated with legs uncrossed for three to five minutes with nothing restricting on the arm, or location of measurement. The measurement physical environment should be silent with no distractions and the patient should remain silent throughout the procedure in order to prevent any inconsistencies. When the blood pressure cuff is placed on the patient’s arm, the cuff bladder should encompass at least eighty percent of the upper arm. If the cuff is fastened with Velcro, the Velcro must be functional. The proper size of cuff should be determined in order to reduce error. According to previous studies, if the cuff size is too large, the individual will appear with a lower blood pressure. If the cuff is too small for the patient, the blood pressure will appear greater than the correct value. The arm position is the final consideration and should always be supported on a firm surface in order to decrease the risk of an increased diastolic blood pressure rate caused from unintentional muscle contraction. The arm is recommended to be kept at heart level. If the blood pressure is taken with the arm lower than heart level, the blood pressure will likely be increased. The opposite effect takes place if the arm is raised above the heart.[15]

MERCURY SPHYGMOMANOMOETER

One of the most common methods in peripheral blood pressure measuring is through the use of a mercury sphygmomanometer. The mercury sphygmomanometer device is used like many others utilizing an inflatable cuff through the restriction of an artery in the arm, leg, or wrist. As the cuff deflates, blood flow resumes and is then measured through the use of Korotkoff sounds. The individual taking the measurement will listen for the Korotkoff sounds through a stethoscope placed over the occluded artery. The mercury sphygmomanometer method has been shown to have an increased amount of inaccuracy, totaling up to 28 percent of failure. Further, the mercury sphygmomanometer method is no longer commonly used due to the health risks of mercury if the device were to break and leak mercury.[15]

ANEROID SPHYGMOMANOMETER

The measurement method that was intended as the replacement of the mercury sphygmomanometer is the aneroid sphygmomanometer. The aneroid sphygmomanometer approach was designed to remove the risk of the mercury contamination, yet uses a similar technique as the mercury cuff. The major difference in the aneroid sphygmomanometer from the mercury is the inside mechanics of the instrument. Within the aneroid sphygmomanometer the mechanisms control the dial due to the pressure changes within the blood pressure cuff. One of the primary issues with aneroid sphygmomanometer is the amount of sensitivity. The device must be handled with care in order to prevent damage, thus resulting in unreliable readings. At best aneroid sphygmomanometer devices operate as well as the mercury sphygmomanometer.[15]

AUTOMATIC BLOOD PRESSURE CUFF

Another popular blood pressure measurement method is through the use of an automatic blood pressure cuff. The automatic blood pressure device is considered more accurate than other peripheral blood pressure measurement instruments due to the decrease in operator error, along with bias. The automatic blood pressure cuff uses a pressure waves to assess peripheral arterial blood pressure. The mean of the blood pressure is measured with the automatic blood pressure sphygmomanometer. One of the issues automatic blood pressure cuffs present is the lack of validation in those with cardiac arrhythmias.[15] Another issue that should be taken into consideration is the overall inaccuracy of the use of the traditional blood pressure cuff. The automatic cuff has been shown to lack sensitivity and tends to show a false negative diagnosis for hypertension.[9]

AMBULATORY BLOOD PRESSURE

One of the most accurate blood pressure measurement methods would be the ambulatory blood pressure measuring (ABPM) approach.[20] The benefit is the ability to take multiple readings at one time, allowing a more comprehensive portrait of the individual's blood pressure. The major issues with the ABPM method is the lack of resources, fitting time, and how the patient perceives it.[18]

CENTRAL BLOOD PRESSURE MEASUREMENT

The method that is considered the most accurate, along with allowing for discovery of other health concerns is the use of central blood pressure measurement. The results of many scientific studies have come to the conclusion that the use of central blood pressure measurement is beneficial for the anticipation of cardiovascular health issues. One of the benefits of central blood pressure measurement is the ability to assess target-organ damage.[17] One study showed the use of a blood pressure cuff to measure central blood pressure may decrease the inaccuracy of the traditional noninvasive measurement methods.[9]

STUDY POPULATION

The population most commonly used throughout studies pertaining to blood pressure included adults over the age of 18 and not involved in athletics or high levels of physical activity. [22,26,7,17,16,9,31,34,28,19] The populations may provide some pertinent information regarding the desired population due to some of the participants being of similar age (18-23 years old). However, the results of the studies do not differentiate the differences in age with the results. The desired population for our purposes includes male collegiate level American Style Football athletes. There were several studies that included collegiate football athletes with Harvard University's football athletes along with Wake Forest University's football athletes. [13,3] The studies provided the most applicable information. An additional study performed on National Football League (NFL) athletes provided information on long term football participation effects. [8]

SOCIAL COGNITIVE THEORY

The Social Cognitive Theory is the most common behavior theory used in nutrition education and research.[4] The theory was originally introduced by Bandura in 1977 and has rapidly gained recognition.[4] The focus behind the theory is determining the causes affecting one's behavior.[4] There are several considerations in the theory such as environmental, personal, and behavioral factors, which act as an influence on the individual's behavior.[4] Specifically, these include factors such as the individual's personal thoughts and feelings, their dietary actions, knowledge, along with external factors such as surroundings.[4] The idea behind the theory is that these factors create a complimentary action.[4]

QUESTIONNAIRE AND EDUCATIONAL TOOL DEVELOPMENT

QUESTIONNAIRE

Many tools have been used to examine risk factors as well as the effectiveness of educational interventions in the treatment and prevention of hypertension. Due to the variety of studies reviewed, the methods in which questionnaires and surveys were used in research studies were vast. Questionnaires measuring overall health were given to parents assessing the health status, exercise levels, and medications of their adolescent children. [30] In the same study, the parents were later asked to perform both a food recall and complete a food frequency questionnaire in order to assess the sodium intake and average snack consumption of their children.[30] In assessing antioxidant intake, a food recall questionnaire was also given.[31] In order to asses nutritional status in another study, a 24 hour food recall was administered on randomized days. [28] When studying the effects of physical activity on blood pressure, a short questionnaire focusing on activity levels was given. [10] Another assessment used the evaluation of hypertension knowledge following use of an educational tool.[11] The educational tool included topics of general knowledge, diet, physical activity, alcohol consumption and cigarette smoking, along with hypertension medications.[11]

ANTHROPOMETRIC AND BLOOD PRESSURE MEASUREMENTS

The research performed specifically with American-Style Football (ASF) players included one in which all varsity male athletes at a National Collegiate Athletics Association (NCAA) Division one university for an extended period of time had their blood pressure recorded.[23] The data were required for the individual's pre-participation physical examinations (PPE) for each season.[23] The information collected was then used to compare hypertension in football athletes to all other male sports.[23] To measure the change in blood pressure levels through one season of ASF participation documented the anthropometric data, resting blood pressure, and left ventricle structure prior to and post one season of competitive football.[33] Assessments of anthropometric data, demographics, clinical characteristics, blood pressure, and arterial function were all measured before and after their first season with the goal of assessing arterial function changes within freshman collegiate ASF season.[24] When anthropometric data was taken from NFL athletes, the examiners had the participants state their current height and weight, rather than measuring the values themselves. [32]

FACTORS AFFECTING BLOOD PRESSURE MEASUREMENTS

Many factors have been shown to have the potential to increase one's measured blood pressure. In studies where arterial stiffness and the association of blood pressure were measured, Doppler Echocardiograph with tissue imaging has been used.[27] In other research, artery flow and cardiac morphology were measured along with blood pressure, anthropometrics, and blood chemistries. The artery flow was evaluated through the use of high-resolution ultrasonography, while the cardiac morphology was performed through a resting electrocardiograph.[27] The blood pressure, anthropometric data, and blood chemistries were all measured.[27] However, in order to properly group participants cardiopulmonary testing to measure the individual's VO2 max, anaerobic threshold, and heart rate reserve were analyzed.[27] Once the analysis was completed they were able to put the participants in groups based on the findings and blood pressure measurements.[27] In another study in which exercise was used in association with hypertension and blood pressure, different forms of physical activity were prescribed to hypertensive patients for a period of time.[8,13] Arterial stiffness, along with blood pressure were then measured through standardized procedures.[8,13]

A final study involving ASF athletes was performed for different purposes and was used to compare hypertension to the race of the individual in NFL athletes. The measurements were performed through the pre-season PPE with height, and medications being self-reported, and weight and blood pressure being recorded. The athletes were then asked to identify their race and the relationship of race and hypertension rates was compared.[32]

ADHERENCE TO BLOOD PRESSURE TREATMENTS

Within the general population the study topics included the primary focus of educational strategies including the evaluation of types of interventions applied to increase patient compliance.[11,7] A variety of methods including self-learning through education booklets, public lecture, and interactive workshop were used.[11] The studies did not specifically pertain to the football or athletics setting, but were still significant in the information provided.

LIMITATIONS

Within the research reviewed, there were several stated limitations to the studies along with areas to be further researched. Amongst the research performed on ASF athletes, many areas require further research. In the study comparing blood pressure and hypertension to left ventricle hypertrophy, the prevalence, determinants, and prognostic significance of hypertension in athletes is an area lacking in research.[5] In addition to that, the study focusing on compliance in blood pressure lowering goals states a more intense intervention method such as interactions with individuals, rather than sending information to practicioners.[7] A change in intervention may be necessary in order to increase hypertension knowledge and how to control it.[7] Studies of the physiological aspects that may affect an athlete's blood pressure are another important research avenue. Research on the topic of prevention methods for vascular diseases within the specific population of ASF athletes is limited and should be further investigated.[24] In addition, other research suggested an investigation in the mechanism(s) of hypertension in football and why NFL players have the tendency of shorter life spans than the general population.[32] With the focus on football and physical activity effects on vascular index of cardiovascular disease – it has been suggested that research should be performed on exercise and the effects of left ventricular hypertrophy and hypertension after exercise is removed from daily activity.[13] A relationship is shown between the physical activity effects on vascular function and the research performed on the effects of ASF on resting blood pressure. There also exists a gap in research on the effects of different types of training and the impact they may have on the athletes.[33] Further research on this topic is important due to the intense training methods of collegiate athletes, along with the varying methods in which they train. The final area requiring more research that has been suggested is the relationship of BMI changes throughout the years of participation and the role it may have played on the individual's blood pressure.[23] There is still much research that is needed on the topic of blood pressure and how blood pressure relates to athletics short-term health and long-term health.

CONCLUSION

The literature on hypertension is expansive in the United States. NCAA male athletes have an increased rate of pre-hypertension and hypertension with ASF participants having a higher prevalence than other sports.[23] An increase in blood pressure often takes place after participation in physical activity and is pertinent due to elevated blood pressure levels leading to a decrease in exercise capacity within athletes.[27] Controlling blood pressure is important for maintaining cardiovascular health and can be done through the use of medications, diet, and physical activity.

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CHAPTER THREE

METHODS

All methods were approved by Clemson University's Institution Review Board (IRB) prior to the research implementation and all procedures were completed in compliance with Clemson University IRB.

Study Participants

The participants in the study included male football athletes from Clemson University ranging in age from seventeen to twenty-three. The individual's ranged in position played and were not chosen specifically by position on the team. Year of National Collegiate Athletic Association (NCAA) eligibility was not considered nor was the race of the individual.

Athlete Identification

Preceding data collection the football roster (in alphabetical order) was taken from the Clemson University athletics website.[1] The individual players were assigned a unique identifier number from a random number table.[3] From the first number selected, every fourth number was chosen and assigned to the next athlete listed alphabetically. Each athlete's identification numbers was entered on the top of the questionnaires as their identifier, rather than their name. Confidentiality of the information collected was protected by ensuring once questionnaires were completed, they were immediately placed in an envelope.

Recruitment and Protocol Implementation

Recruitment and measurements were taken in the Clemson University Football Athletic Training Room. As the athletes entered the athletic training room they were asked to participate in the study by the primary investigator. They were given the option to participate or not. If they agreed to participation, the individual was then asked to first fill out the consent form stating what the study entailed along with their role in participation. After completing the consent form, they were then given a one page double-sided questionnaire (appendix A) and asked to answer the questions to the best of their ability. If questions were asked by the athletes while completing the questionnaire, they were directed to answer the question according to their own interpretation of the question. Filling out the questionnaire took approximately 5-10 minutes. After questionnaire completion each athlete's blood pressure was taken.

Blood Pressure Measurements

Each individual was asked to sit in a cushioned chair with their arms relaxed and at their side. The standard adult blood pressure cuff was applied to all participants and was assessed if the fit was proper or not by the size range marked on the blood pressure cuff. If the arm width exceeded the range, the standard cuff was removed and a larger cuff was applied. The selected cuff was fastened using Velcro. The athlete was then asked to refrain from movement or speaking. Two measurements were taken for each individual and then averaged. Blood pressure measurements were taken with an OmRon (HEM-907XL) automated sphygmomanometer. The blood pressure cuff was removed and adjusted prior to the completion of the second measurement. If an error occurred the cuff was removed and the machine was turned off and then back on. The cuff was then reapplied and the measurement was taken.

Educational Tool Development and Administration

An educational tool (appendix B) was given to the athletes who participated in the mid-season measurement two times during the season. The educational tool was developed from information gained from the American Heart Association.[5] The first round of educational tools were provided to the athletes through placing a printed color copy in the locker of the individuals. Attached to the educational tools was the consent form the participant previously signed. The papers were folded in half with the consent form being the outside paper. The papers were placed in the participating athletes' lockers one week after data collection had been completed on December 7th 2015 at 2:30pm. Educational tools were sent to the participants a second time via university email, indicated as a preferred method of education information delivery on the study questionnaire. Email addresses were collected from the university phonebook located on the Clemson University website. The email was sent out immediately post season and one week prior to the post season data collection. The email was sent on January 29th, 2016 at 1:12pm.

Questionnaire Development and Analysis

Social Cognitive Theory was used to inform the survey development. Time constraints of the study population to complete a questionnaire was also a primary factor in the survey development and an additional incentive to have the pilot testing of the questionnaire completed by a male, athlete population. Therefore, in preparing the questionnaire for this study, previously used validated survey and/or easily accessed and recognized instruments (from the NHANES II/CDC[7], WHO[8], Johns Hopkins[9], American Heart Association (AHA)[10]) were reviewed and recurring themes and questions were incorporated into the final athletes questionnaire. In addition, some questions from a previous questionnaires (validated) used in an athletics study at the university were analyzed and portions were adapted into the questionnaire provided to the study participants (unpublished results). The dietary intake sections were based from the previous questionnaire. In preparing questions for the knowledge section, information obtained through the literature review, questionnaires cited above, and the American Heart Association[5] were used (this information was also used to create the educational tool, previously mentioned). General knowledge questions (8), along with causes of high blood pressure (8) were taken directly from the educational tool developed. As previously mentioned, the questionnaire was based off of the tenets of social cognitive theory due to examining the many environmental and self-factors which could elicit an effect on an athlete's blood pressure.[6]

The dietary portion of the questionnaire examined how many times per week the athlete ate at each of the following locations: on-campus cafeteria, on campus food establishment (not a cafeteria), fast food, restaurant, home self-prepared meal, home pre-packaged meal, West End Zone PAW, weight room snack bar, and skipped meal. Five answer choices were provided including: 0 times/week, 1-2 times/week, 3-5 times/week, 6-8 times/week, 9+ times/week. The dietary food intake was also assessed through logging intake for the following: fruits, vegetables, whole grains, lean meats, low-fat dairy, salty snacks, sweet snacks, and condiments. The choices for the dietary food intake were: 0 times/day, 1-2 times/day, 3-4 times/day, 5-7 times/day, 7+ times/day. A food frequency table was used rather than a 24-hour recall due to the reduced amount of time a food frequency table requires. The data from the reported food frequency intake allows for a better measurement of normal eating habits of the individual.

The examination of the physical activity of the participants regarded how many times per week the athletes participated in different forms of exercise. The participants were asked to provide how many times a week they participated in lifting heavy weights and conditioning exercise. For each of the physical activity categories, response options were: 0 times/week, 1-2 times/week, 3-5 times/week, 6+ times/week.

Athletes were also asked a variety of other questions in order to evaluate other factors known to affect blood pressure, especially in athletes. In order to assess stress levels within the athlete, the athletes were asked if they were currently injured and the duration of the injury. They were also asked to document their sleeping habits by choosing the average amount of sleep obtained at night. The options provided included: 8-10 hours, 6-8 hours, 4-6 hours, less than 4 hours. A multiple choice question regarding what influences their entrée choice most at a restaurant was asked with answer choices of: price, taste, healthiness, advertisements, what others in your party choose, and other.

Position on the team was also asked to be provided by the athletes on the questionnaire as this can affect body weight, exercise regimen, etc. that may result in blood pressure alterations. Athletes were also asked whether they been told previously if they have high blood pressure. The answer options were yes or no, requiring the individual to circle the most correct answer choice. If the participant answered yes to having previously been told they had high blood pressure, they were asked to provide the method in which they are controlling their blood pressure. Four answer choices were provided: diet, physical activity, medication, and other. If "other" was chosen, they were asked to write in their method of blood pressure control.

A pilot study was conducted to consider questions that may be difficult to understand. A final question was placed on the pilot study questionnaire requesting any changes that the participants would recommend. The pilot study population was composed of ten male cheerleaders. The suggestions were taken into consideration and changes were made as necessary. Changes included separating the choice of a good blood pressure into a separate selection of the best SBP and DBP from a range provided for each (appendix A). Some multiple choice questions were converted into True/False questions to provide a more consistent format for the questionnaire and to decrease the participation time. Also, redundant questions on the pilot questionnaire were removed from the final questionnaire.

The study results from the questionnaire were logged in an Excel spreadsheet. Each individual question was given a code and numbers were assigned to each code corresponding with the possible answers. The questions assessing blood pressure knowledge were combined into an overall knowledge score through averaging the percent correct for each individual question. Blood pressure knowledge questions were used to measure the difference in knowledge between the mid-season measurement and post-season measurement. The dietary recall questions were assessed through the calculation of percentages of each answer choice. Increases and decreases in the dietary intake percentages were compared between mid-season and post season measurements. . Answer choices for the dietary intake category were coded as 0,1,2,3,4.

Statistical Analysis

SAS software was used to perform analysis.[2] In order to determine knowledge prior and post educational tool implementation, a general knowledge score for each individual was established by finding the percent of the knowledge questions that were correct. The change in the knowledge score is reflected by subtracting the pre knowledge score from the post knowledge score. Normality was judged using the distribution of the change in the knowledge scores. The non-parametric Sign Rank test was used to examine if there were significant changes in knowledge from pre to posttest when normality was not satisfied.[4] When data were normally distributed a t test was conducted to test for significance.[4] For the dietary and physical activity portions, the mid-season questionnaire data were subtracted from the post-season data to examine changes using the coded responses. Descriptive statistics were found for the questions regarding dining out meal decisions, previous history of hypertension, position played on the team, previous injury and sleep patterns, and whether or not the respondents reviewed the educational tools.[4] These analyses were conducted for the overall sample as well as for those that indicated that they had reviewed the educational tools.

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CHAPTER FOUR

RESULTS:

Table 1. includes the demographic information of the participants. Participants were all between the ages of 18-23 years (average 20 yrs. ± 1.3 yrs.). The height varied between 67-77 inches (mean 74 in. ± 2.7 in.) and the weight between 169-336 lbs (mean 236 lbs ± 50 lbs). A family history of hypertension was noted in 37 of the 47 participants (79%), while 10 athletes (21%) did not have a family history of hypertension.

Table 1. Study Participant Demographics

Variable	Lineman	Skill Position
Age (yrs.)	20 ± 1.3	20 ± 1.3
Height (in.)	75 ± 2.2	73 ± 2.8
Weight (lbs.)	277 ± 37	199 ± 25
Family History		
Yes	68 (22)	76 (25)
No	32 (22)	24 (25)

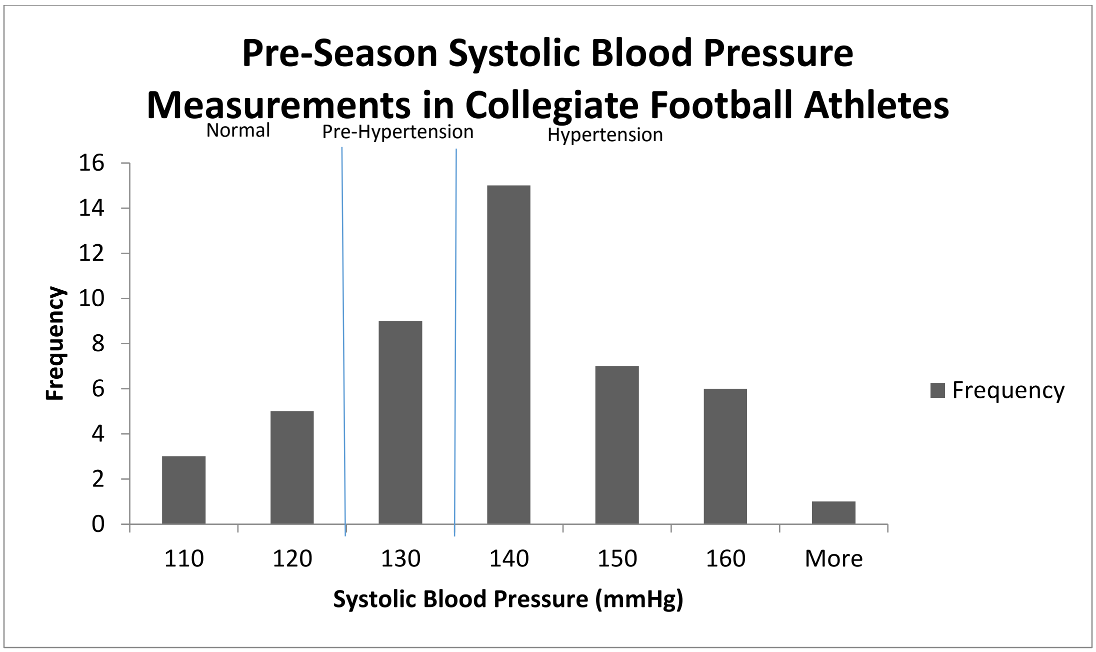
*age, height, and weight are shown as mean ± SD; family history is shown as % (n)

The position that the individual's played on the team included: offensive line (OL), defensive line (DL), linebacker (LB), wide reciever (WR), defensive back (DB), tight end (TE), quarterback (QB), long snapper (LS), kicker (K), and punter (P). The OL group included 10 participants (21%), the DL group included 7 individuals (15%), LB included 5 individuals (11%), WR had 7 participants (15%), DB had 5 participants (11%), the TE group had 5 participants (11%), 2 QBs participated (4%), LS had 2 participants (4%), K had 3 individuals (6%), and 1 P participated (2%). A total 47% (22 participants) of the study population were lineman, with the remaining 53% (25 individuals) participating in skill positions.

Hypertension Prevalence

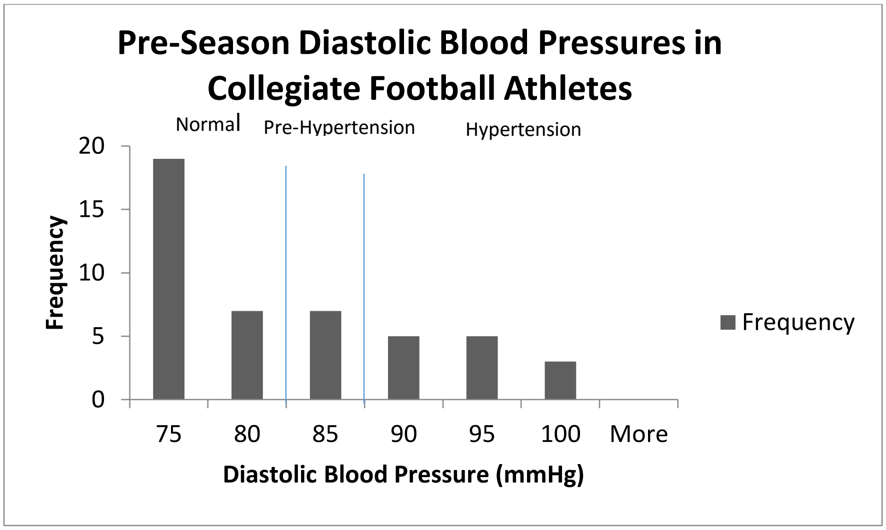
Within the pre-season systolic blood pressure measurements (Figure 1), 8 individuals appeared with blood pressure within normal limits (≤120 mmHg). The pre-hypertensive range (121-139 mmHg) included 9 individuals, with the hypertensive range (≥140 mmHg) consisted of 29 individuals.

Figure 1



The diastolic blood pressure among the pre-season measurements (Figure 2) consisted of 26 athletes within the normal range (≤80 mmHg). The pre-hypertensive measurements (81-89 mmHg) included 7 individuals, with the hypertensive range including 13 individuals (n=47).

Figure 2



The mid-season systolic blood pressure measurment (Figure 3) consisted of 4 individuals in the normal blood pressure range, 15 in the pre-hypertensive range, and 28 in the hypertensive range. The diastolic blood pressure measurements (Figure 4) included 30 within normal blood pressure range, 10 within the pre-hypertensive range, and 7 in the hypertensive range.

Figure 3

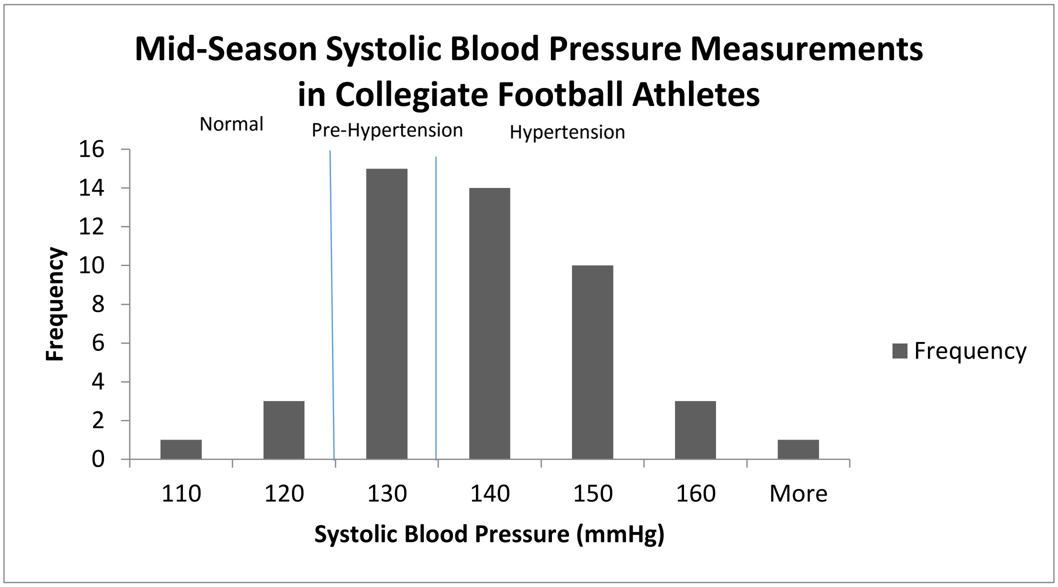
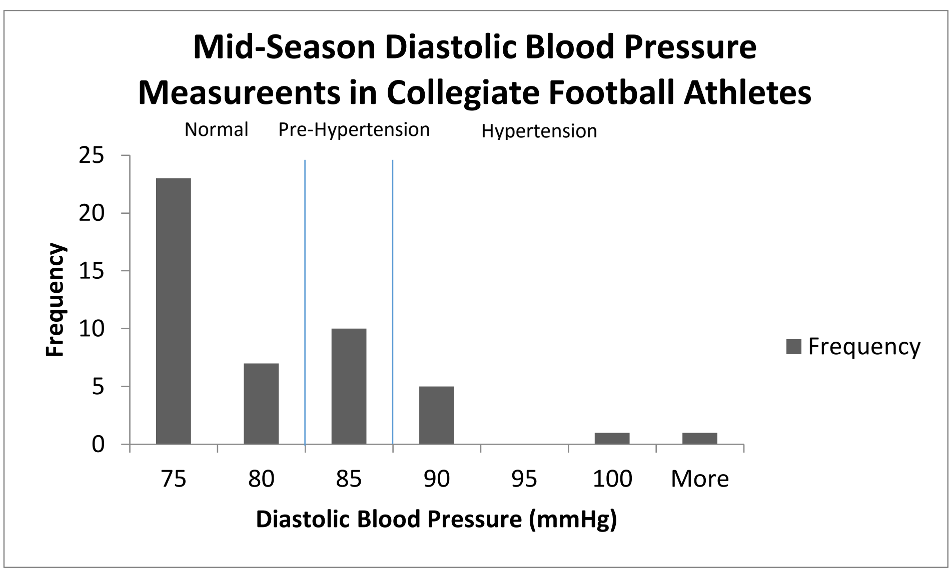


Figure 4



Post-season systolic blood pressure measurements (Figure 5) included 15 individuals (n=47) within the normal blood pressure range, 13 individuals in the pre-hypertensive range, and 19 in the hypertensive range. The post-season diastolic blood pressure data (Figure 6) consisted of 37 individuals, the pre-hypertensive range included 3 individuals, and the remaining 7 were hypertensive.

Figure 5

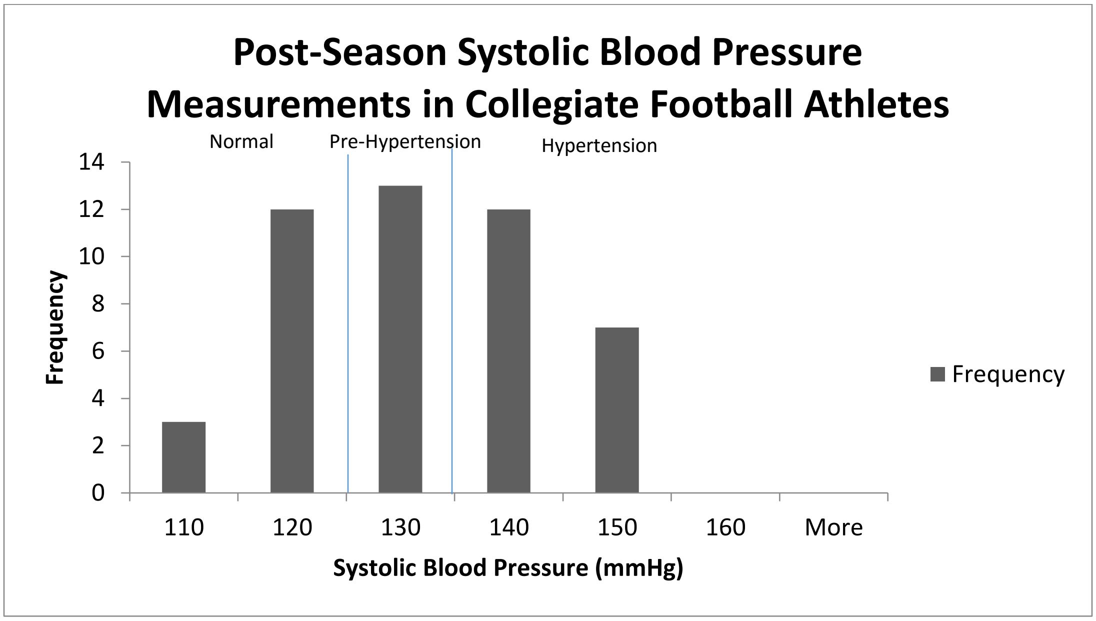
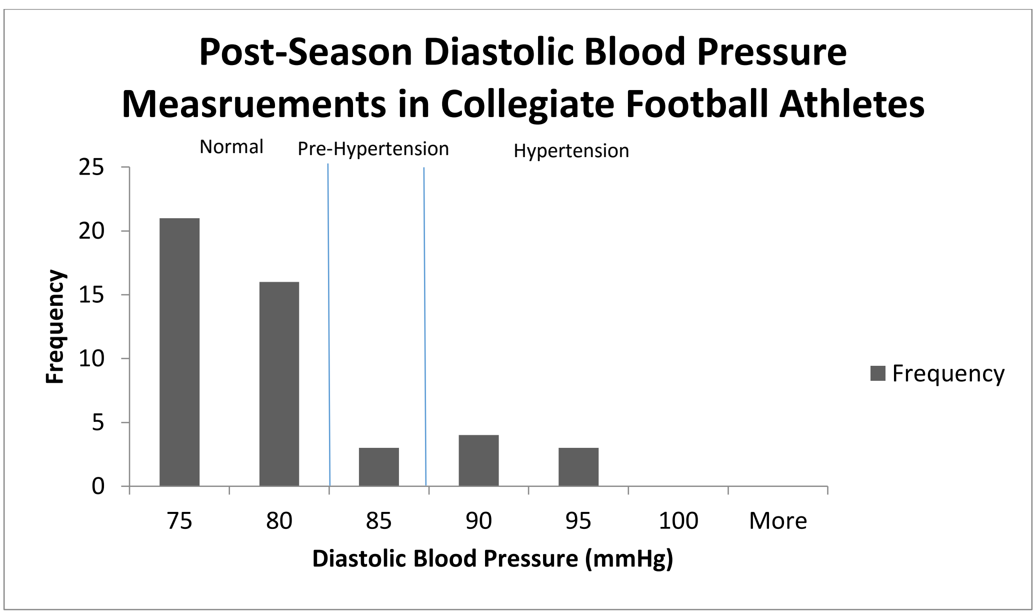


Figure 6



Change in Blood Pressure

Systolic blood pressure measurements appeared normally distributed (N=47, Shapiro-Wilk P=0.9435). The average change in systolic blood pressure from pre- to mid- season was 0.17 mmHg (SD=11.91 mmHg). The change in systolic blood pressure was not statistically significant from pre- to mid-season (t=0.098, p=0.9224).

The change in diastolic blood presssure between the pre-season and mid-season blood pressure measurements was not statistically significant (t=-0.9783, p=0.5266) with an average change of -1.34 mmHg (SD=10.6 mmHg). The data were normally distributed (N=47, Shapiro-Wilk P=0.5266).

The systolic blood pressure measurements between the post-season and mid-season appeared normally distributed (Shapiro-Wilk P=0.1548). A significant change in the systolic blood pressure was observed (t=3.65, p=0.0007). The mean difference in the systolic blood pressure from mid- to post-season was -6.7 mmHg with (SD=12.3 mmHg).

The diastolic blood pressure changes between mid- to post-season were normally distributed (N=45, Shapiro-Wilk score P=0.8333). The change in the diastolic blood pressure was not statistically significant (t=-1.267, p=0.2119). The mean change in diastolic blood pressure between the post-season and mid-season had a mean of -1.64 mmHg (SD=8.71 mmHg).

Educational Tool Participants

The data of the individuals who took part in reviewing the educational tool was analyzed both with the entire study group, as well as separately. The change in general blood pressure knowledge data for those that reviewed the educational tool, shown in Table 2 and Figure 7, averaged a change of -0.018 (N=15, SD=0.1374) which showed to be statistically insignificant (S=-7.5, p=0.8125). The data did not appear to be normally distributed (Shapiro Wilk P=0.0043). The average change in causes of blood pressure increases knowledge (Table 3, Figure 8.) -0.039 (N=15, SD=0.2087). The data were normally distributed (Shapiro Wilk P=0.0518) and did not display a significant change (t=-0.729, p=0.478).

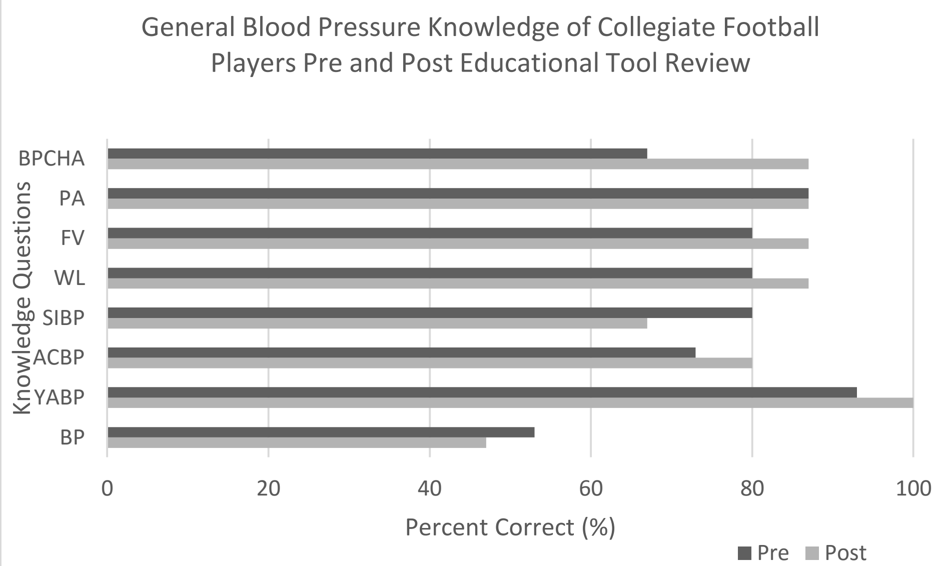
Table 2

General Blood Pressure Knowledge Pre- and Post-Educational Tool

	Pre Correct %	Post Correct
Most people can tell when their blood pressure is high because they feel bad. (False)	53	47
Young adults do NOT have high blood pressure. (False)	93	100
Alcohol consumption lowers blood pressure. (False)	73	80
Lowering salt intake has been shown to be beneficial for lowering blood pressure. (True)	80	67
When you lift heavy weights, your blood pressure increases. (True)	80	87
Eating more fruits, vegetables, whole grains and low fat dairy can lower your blood pressure. (True)	80	87
When you are active, it is normal for your blood pressure to increase, but once the activity stops your blood pressure will return to your normal baseline range. (True)	87	87
It is NOT normal for blood pressure to change when you sleep, wake up, are excited or are nervous. (False)	87	87
Average knowledge score	77 (±12.4)	80 (±16.3)

n = 15; average score=mean±SD

Figure 7



All of the following are True or False:
BPCHA=It is NOT normal for blood pressure to change when you sleep, wake up, are excited or are nervous; PA=When you are active, it is normal for your blood pressure to increase, but once the activity stops your blood pressure will return to your normal baseline range; FV= Eating more fruits, vegetables, whole grains and low fat dairy can lower your blood pressure; WL=When you lift heavy weights, your blood pressure increases; SIBP= Lowering salt intake has been shown to be beneficial for lowering blood pressure; ACBP=Alcohol consumption lowers blood pressure; YABP= Young adults do NOT have high blood pressure; BP= Most people can tell when their blood pressure is high because they feel bad.

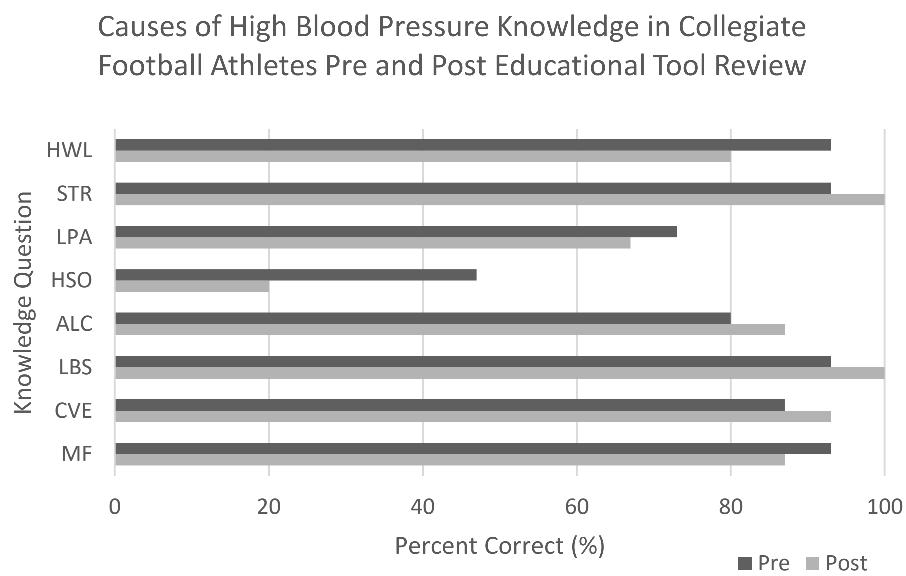
Table 3

Causes of 'High Blood Pressure' Knowledge Pre- and Post-Educational Tool

	Pre Correct (%) n	Post Correct
If your mother or father have high blood pressure, your chance of also having high blood pressure is high. (True)	93	87
Cardiovascular/aerobic exercise increases your blood pressure. (True)	87	93
Being overweight or obese can lead to high blood pressure. (True)	93	100
Drinking excess amounts of alcohol will NOT increase the risk for high blood pressure. (False)	80	87
High dietary salt intake always causes high blood pressure. (False)	47	20
Lack of physical activity can cause high blood pressure. (True)	73	67
Stress can raise your risk for high blood pressure. (True)	93	100
Lifting heavy weights can temporarily increase blood pressure but does NOT cause lasting high blood pressure (also known as hypertension). (True)	93	80
Average Knowledge Score	82±16.1	79±26.3

n = 15

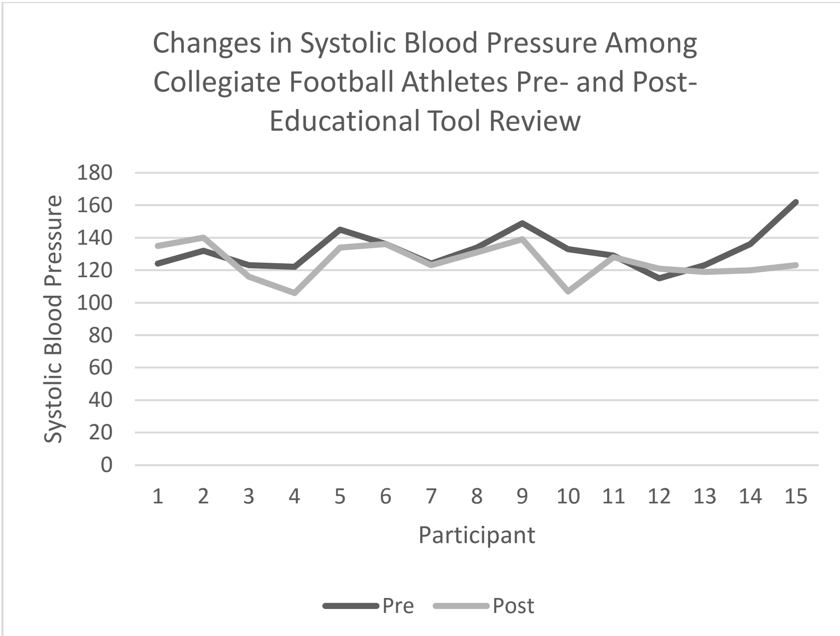
Figure 8



The following are true false questions from the questionnaire: HWL=Lifting heavy weights can temporarily increase blood pressure but does NOT cause lasting high blood pressure (also known as hypertension); STR=Stress can raise your risk for high blood pressure; LPA=Lack of physical activity can cause high blood pressure; HSO=High dietary salt intake always causes high blood pressure; ALC=Drinking excess amounts of alcohol will NOT increase the risk for high blood pressure; LBS=Being overweight or obese can lead to high blood pressure; CVE=Cardiovascular/aerobic exercise increases your blood pressure; MF=If your mother or father have high blood pressure, your chance of also having high blood

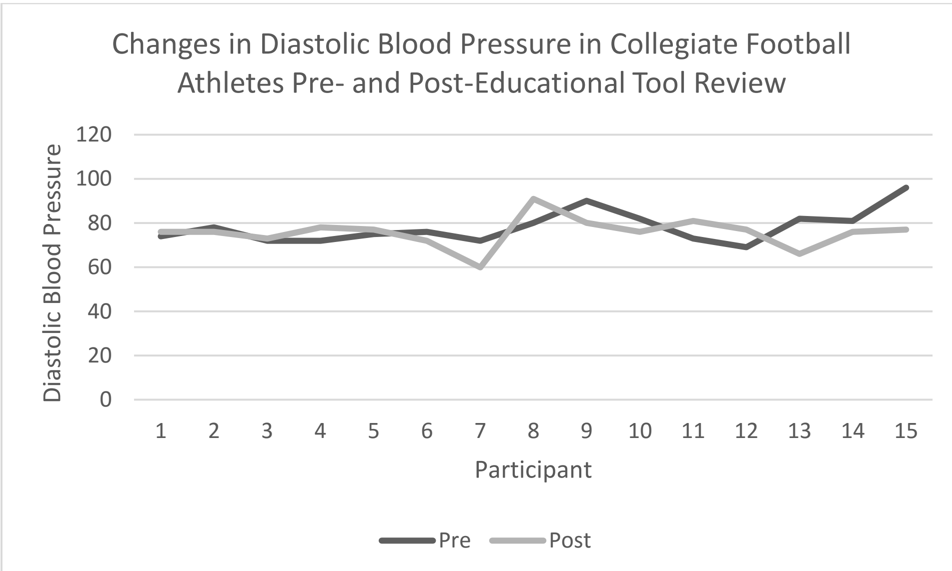
The changes in systolic blood pressure among the participants who reviewed the educational tool are shown in Figure 9. The average change was -7.3 mmHg (N=15, SD=13.2 mmHg) and was significant (t=-2.13, p=0.051). The data were normally distributed (Shapiro Wilk P=0.3646).

Figure 9



The changes in diastolic blood pressure after review of the educational tool are shown in Figure 10. The changes were normally distributed (N=15, Shapiro Wilk P=0.7661), but were not statistically significant (t=-1.02, p=0.3224). The average change was -2.4 mmHg (SD=9.06 mmHg).

Figure 10



Family History of Hypertension

Individuals who claimed they had a family history of hypertension made up 76% of the study (n=34). The average blood pressure of participants with a family history of hypertension is shown in Table 4 for each of the three data collection time points (pre-, mid-, and post-season). The changes in systolic between the pre-, mid-, and post-season are shown in Figure 11, and diastolic changes are shown in Figure 12.

Table 4

Average Systolic and Diastolic Blood Pressures of Collegiate Football Athletes with a Family History of Hypertension

	Systolic	Diastolic
Pre-Season	133 ± 15.2 mmHg	79.7 ± 10.8 mmHg
Mid-Season	135 ± 11.3 mmHg	76.8 ± 9.53 mmHg
Post-Season	127 ± 11.5 mmHg	75.6 ± 9.42 mmHg

N=34

Figure 11

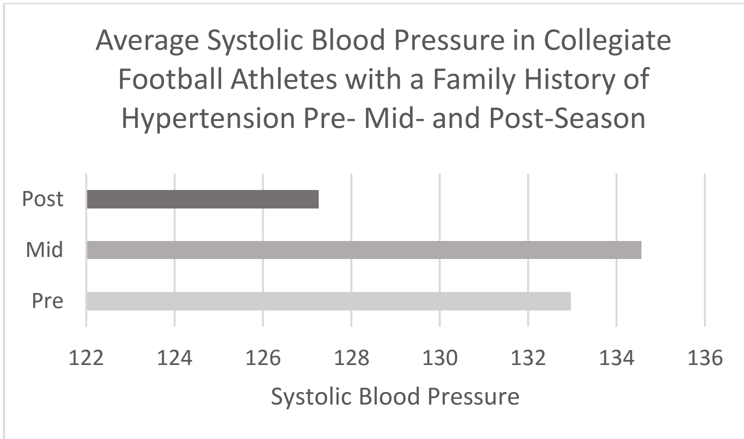
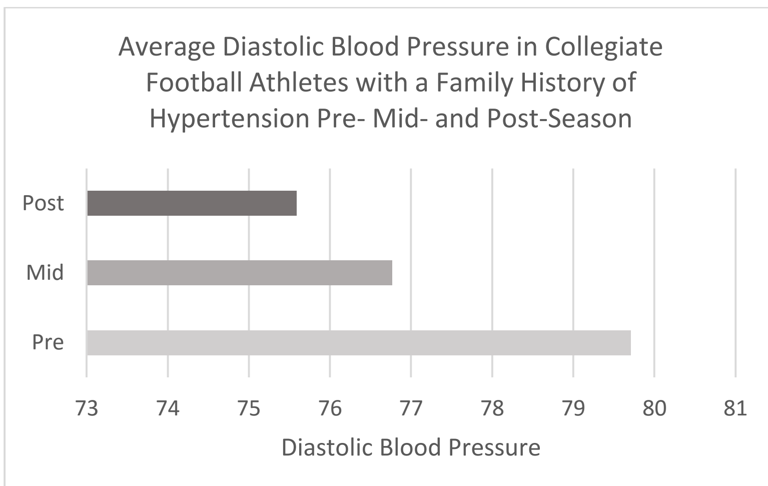


Figure 12



The blood pressures of individuals with a family history were categorized into levels of blood pressure (Table 5). The systolic blood pressure of the pre-season group consisted of 18% within normal limits, 50% were pre-hypertensive, and 32% were hypertensive. The systolic blood pressures of the mid-season group consisted of 6% normal, 62% pre-hypertensive, and 32% hypertensive. The systolic blood pressures of the post-season group included 32% normal, 50% pre-hypertensive, and 18% hypertensive.

The diastolic blood pressures for the pre-season measurement of the participants with a family history of hypertension consisted of 53% normal, 26% pre-hypertensive, and 21% hypertensive. The mid-season measurements included 65% normal, 26% pre-hypertensive, and 9% hypertensive. The post-season blood pressures consisted of 70% normal, 15% pre-hypertensive, and 15% hypertensive.

Table 5

Systolic and Diastolic Blood Pressure Ranges Among Collegiate Football Athletes with a Family History of Hypertension

Systolic Blood Pressure	Pre-Season	Mid-Season	Post-Season
Normal (≤120 mmHg)	18	6	32
Pre-Hypertension (121-139 mmHg)	50	62	50
Hypertension (≥140 mmHg)	32	32	18
Diastolic Blood Pressure	**Pre-Season**	**Mid-Season**	**Post-Season**
Normal (≤80 mmHg)	53	65	71
Pre-Hypertension (81-89 mmHg)	26	26	15
Hypertension (≥90)	21	9	15

N=34; *all values shown are percentages

Change in Knowledge

The changes in general blood pressure knowledge were not normally distributed (Shapiro-Wilk P=0.0104). The change between post-educational tool general blood pressure knowledge and the pre-educational tool general blood pressure knowledge (Table 6, Figure 13) was not statistically significant (S=-5, p=0.9219). The mean change in blood pressure knowledge score was -0.005 (SD=0.12).

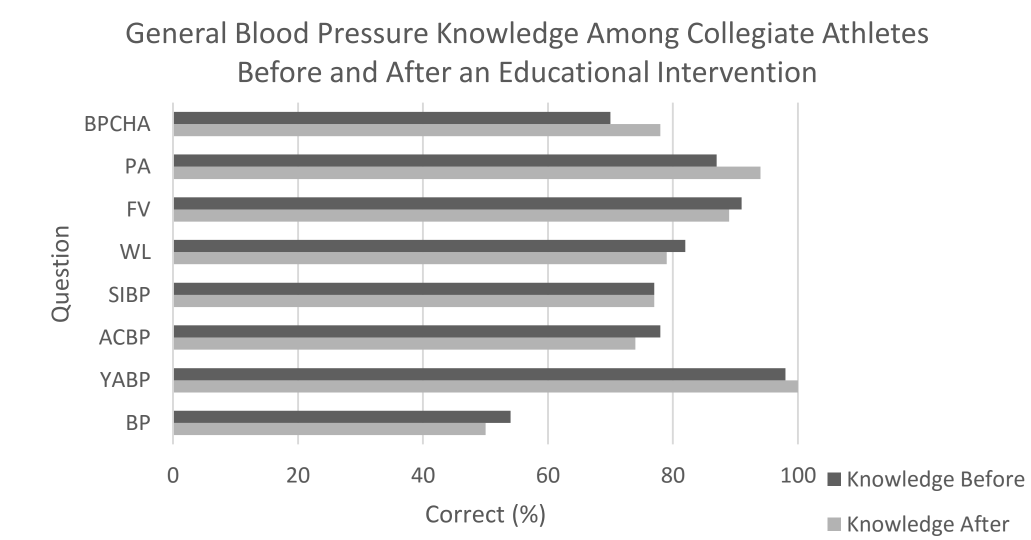
Table 6

<u>**General Blood Pressure Knowledge Pre- and Post-Educational Tool**</u>

	Pre Correct (%) n	Post Correct
Most people can tell when their blood pressure is high because they feel bad. (False)	54 (46)	50 (46)
Young adults do NOT have high blood pressure. (False)	98 (46)	100 (47)
Alcohol consumption lowers blood pressure. (False)	78 (45)	74 (47)
Lowering salt intake has been shown to be beneficial for lowering blood pressure. (True)	77 (45)	77 (47)
When you lift heavy weights, your blood pressure increases. (True)	82 (45)	79 (47)
Eating more fruits, vegetables, whole grains and low fat dairy can lower your blood pressure. (True)	91 (46)	89 (47)
When you are active, it is <u>normal</u> for your blood pressure to increase, but once the activity stops your blood pressure will return to your normal baseline range. (True)	87 (46)	94 (47)
It is NOT normal for blood pressure to change when you sleep, wake up, are excited or are nervous. (False)	70 (46)	78 (46)
Average knowledge score	83 (±0.16)	84 (±0.16)

n = number participants per question

Figure 13



All of the following are True or False:
BPCHA=It is NOT normal for blood pressure to change when you sleep, wake up, are excited or are nervous; PA=When you are active, it is <u>normal</u> for your blood pressure to increase, but once the activity stops your blood pressure will return to your normal baseline range; FV= Eating more fruits, vegetables, whole grains and low fat dairy can lower your blood pressure; WL=When you lift heavy weights, your blood pressure increases; SIBP= Lowering salt intake has been shown to be beneficial for lowering blood pressure; ACBP=Alcohol consumption lowers blood pressure; YABP= Young adults do NOT have high blood pressure; BP= Most people can tell when their blood pressure is high because they feel bad.

The change between the post educational tool questionnaire and the pre educational tool questionnaire regarding knowledge about causes of high blood pressure was not normally distributed (N=46, Shapiro-Wilk P=0.0028). The change in score was not significant (S=2.5, p=0.9473). The mean change in scores between the two measurements was -0.02% (SD=0.199).

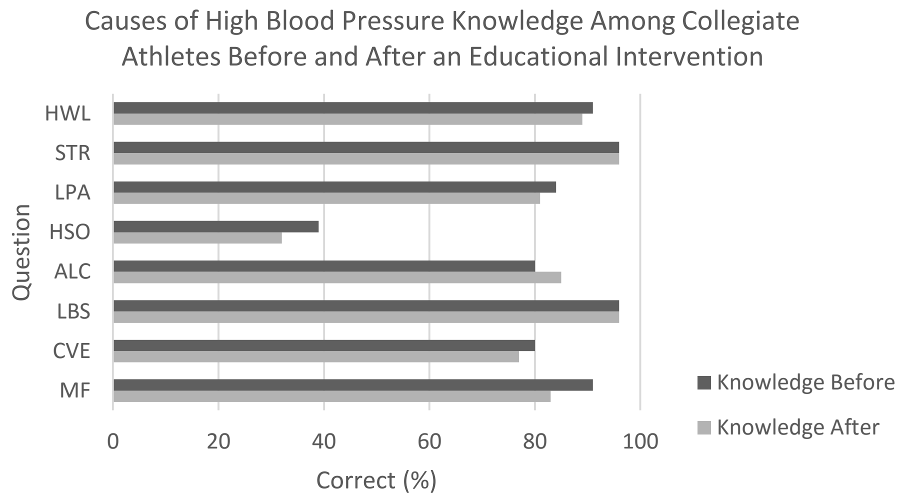
Table 7

<u>Causes of 'High Blood Pressure' Knowledge Pre- and Post-Educational Tool</u>

	Pre Correct (%) n	Post Correct
If your mother or father have high blood pressure, your chance of also having high blood pressure is high. (True)	91 (46)	83 (47)
Cardiovascular/aerobic exercise increases your blood pressure. (True)	80 (46)	77 (47)
Being overweight or obese can lead to high blood pressure. (True)	96 (46)	96 (47)
Drinking excess amounts of alcohol will NOT increase the risk for high blood pressure. (False)	80 (46)	85 (47)
High dietary salt intake always causes high blood pressure. (False)	39 (46)	32 (47)
Lack of physical activity can cause high blood pressure. (True)	84 (45)	81 (47)
Stress can raise your risk for high blood pressure. (True)	96 (46)	96 (47)
Lifting heavy weights can temporarily increase blood pressure but does NOT <u>cause</u> lasting high blood pressure (also known as hypertension). (False)	91 (46)	89 (47)
Average Knowledge Score	77 (±0.20)	74 (±0.20)

n = number participants per question

Figure 14



The following are true false questions from the questionnaire: HWL=Lifting heavy weights can temporarily increase blood pressure but does NOT cause lasting high blood pressure (also known as hypertension); STR=Stress can raise your risk for high blood pressure; LPA=Lack of physical activity can cause high blood pressure; HSO=High dietary salt intake always causes high blood pressure; ALC=Drinking excess amounts of alcohol will NOT increase the risk for high blood pressure; LBS=Being overweight or obese can lead to high blood pressure; CVE=Cardiovascular/aerobic exercise increases your blood pressure; MF=If your mother or father have high blood pressure, your chance of also having high blood pressure is high.

Dietary Establishment

Table 8

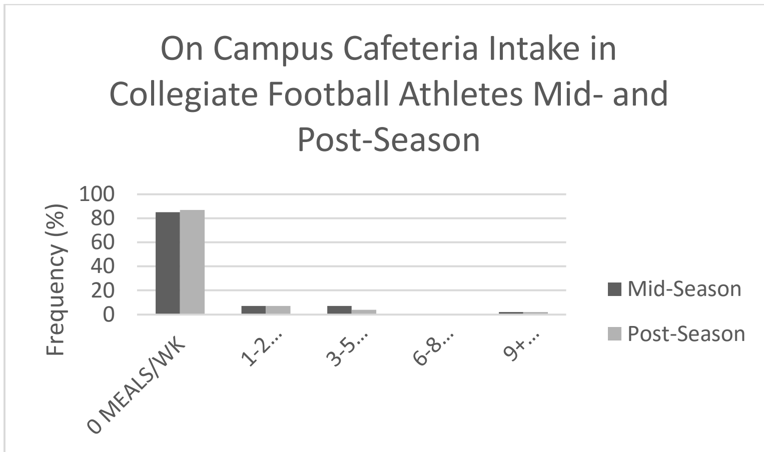
Food Establishment Percentages Pre- and Post-Educational Tool in Collegiate Football Athletes
n = 47; Percent Chosen

		0/wk	1-2 meals/wk	3-5 meals/wk	6-8 meals/wk	9+ times/wk
On campus Cafeteria	Pre^	85	7	7	0	2
	Post	87	7	4	0	2
On campus food establishment other than a Cafeteria	Pre ^^	43	41	14	2	0
	Post	36	47	17	0	0
Fast Food	Pre	2	56	34	4	4
	Post ^	2	52	35	9	2
Restaurant	Pre^	11	56	30	1	0
	Post ^	4	57	35	4	0
Home (self-prepared meal)	Pre*	25	53	18	4	0
	Post ^	9	46	39	4	2
Home (prepackaged/frozen meal)	Pre**	50	42	8	0	0
	Post^^	32	43	23	2	0
West End Zone (PAW)	Pre	0	11	23	30	36
	Post	4	9	62	17	8
West End Zone weight room	Pre*	16	44	29	9	2
	Post	12	17	59	6	6
Skip Meal	Pre +	30	61	9	0	0
	Post	55	36	7	2	0

^n=46; ^^n=44; *n=45; **n=38; +n=44

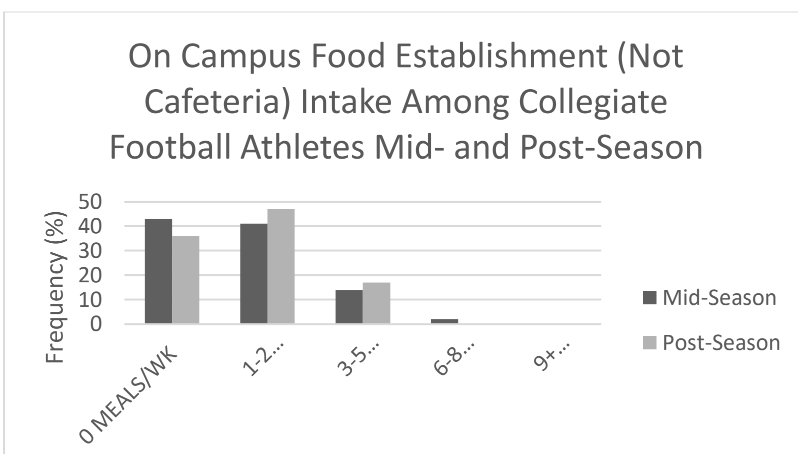
The change in dietary establishment intake is shown in Table 8. The data collected regarding dining at an on campus cafeteria (Figure 15) was not normally distributed (N=45, Shapiro-Wilk P=0.0001) and did not show a significant change (S=-1, p=1.000).

Figure 15



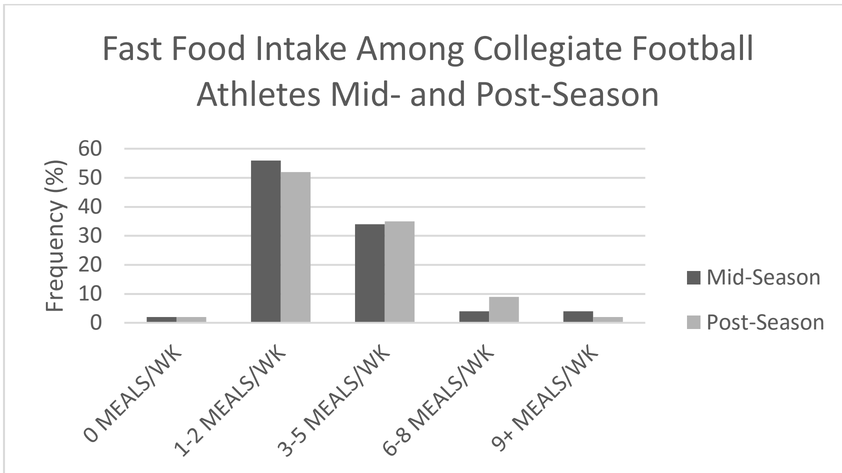
Obtaining meals from on campus food establishment outside of the cafeteria change between mid-season and post-season (Figure 16) was not normally distributed (N=43, Shapiro-Wilk P=0.0019), nor was the change significant (S=31.5, p=0.4070).

Figure 16



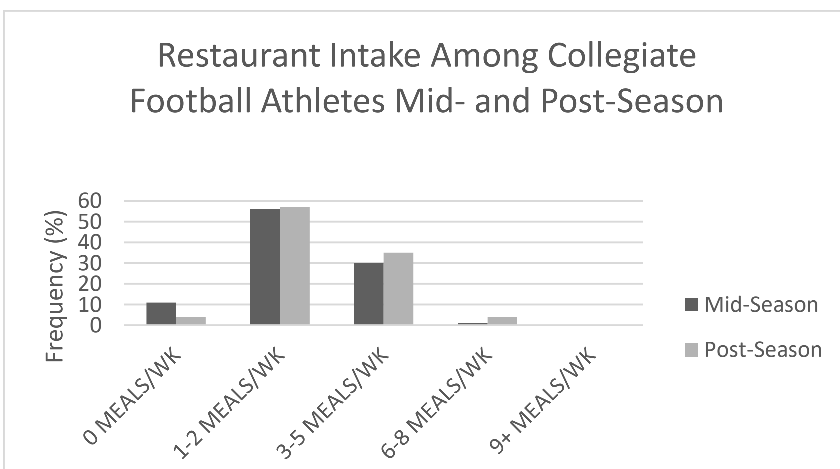
The average change in fast food intake between post-season intake and mid-season intake (Figure 17) was not normally distributed (Shapiro-Wilk P=0.0001) and a significant change was not apparent (S=-4, p=1.000).

Figure 17



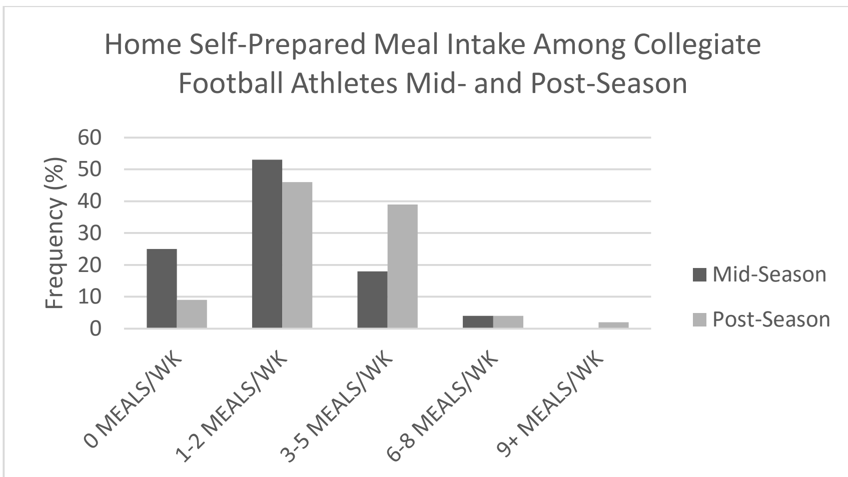
The intake of meals at restaurants not considered fast food (Figure 18) was not normally distributed (N=44, Shapiro-Wilk P=0.0001). The change reported was significant (S=45, p=0.0636).

Figure 18



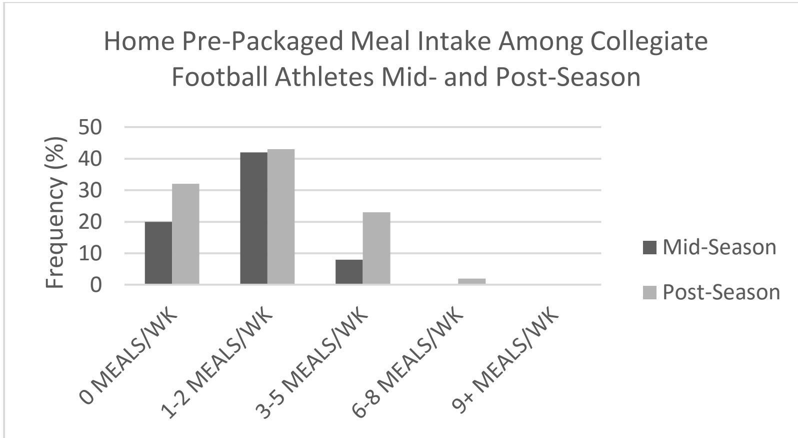
Meal intake that was self-prepared at home (Figure 19) included 43 information from participants (N=43) that they most often ate at restaurants for one to two meals per week, followed by 3-5 meals/week. The change from mid-season intake to post-season intake was significant (S=99.5, p=0.0049). The data were not distributed normally (Shapiro-Wilk P=0.011).

Figure 19



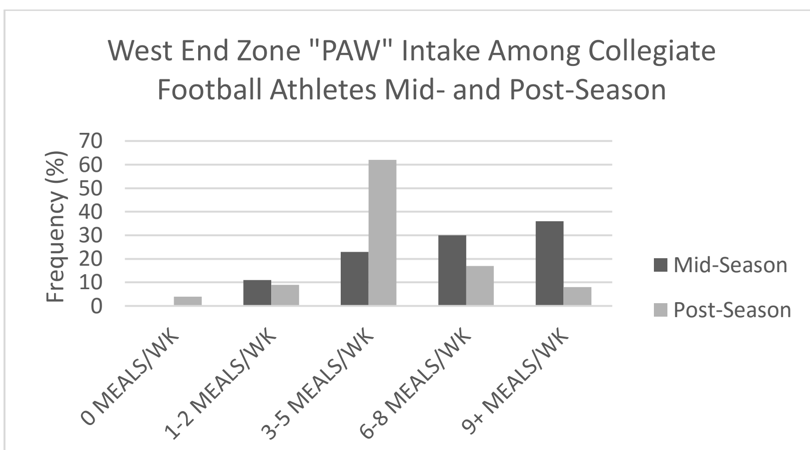
Athletes (N=35) answering the section on home pre-packaged meal intake (Figure 20) indicated that more home pre-packaged meals were consumed post season. The data were not normally distributed (Shapiro-Wilk P=0.0004) but was statistically significant (S=71, p=0.0022).

Figure 20



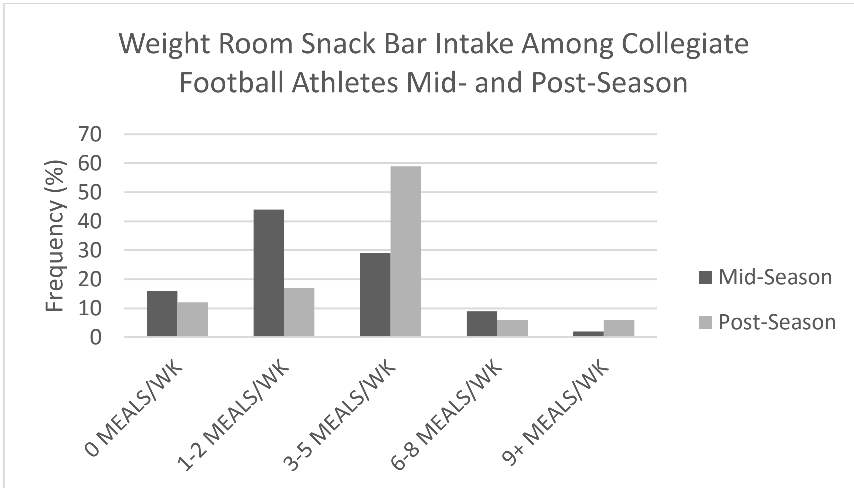
Meal intake at the PAW cafeteria (Figure 21) included 46 study participants. The change between the mid-season measurement and the post-season measurement was significant (S=-167, p=0.0001). The data was not normally distributed (Shapiro-Wilk P=0.0003).

Figure 21



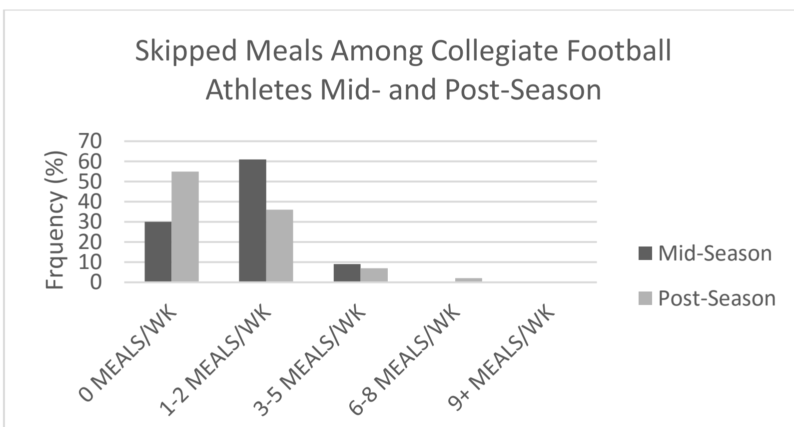
The number of individuals (N=44) who reported meals consumed in the weight room (Figure 22) was not normally distributed (Shapiro Wilk P=0.0001) but a significant change was noted (S=115, p=0.0027).

Figure 22



The change in number of athletes (N=43) who reported that they skipped meals between mid-season and post-season (Figure 23) was statistically significant (S=-61.5, p=0.0044). The data did not show a normal distribution (Shapiro-Wilk P=0.0001).

Figure 23



Food Intake

Table 9

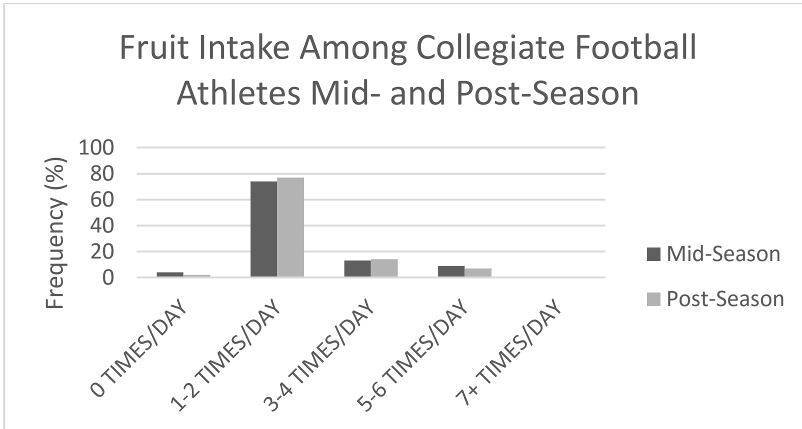
Food Intake Pre- and Post-Educational Tool in Collegiate Football Players
n=44 **Percent Chosen**

		0 times/day	1-2 times/day	3-4 times/day	5-6 times/day	7+ times/day
Fruit	Pre*	4	74	13	9	0
	Post	2	77	14	7	0
Vegetables	Pre*	9	63	22	6	0
	Post	2	73	18	7	0
Whole Grains	Pre**	5	53	31	9	2
	Post^	7	63	26	2	2
Lean Meats	Pre*	0	39	50	11	0
	Post	0	50	43	7	0
Low fat dairy	Pre**	9	76	13	2	0
	Post^^	12	69	14	5	0
Salty Snacks	Pre**	9	76	9	2	4
	Post	12	55	23	7	3
Sweet Snacks	Pre	11	41	41	5	2
	Post	21	57	16	4	2
Condiments (ketchup, mustard, BBQ Sauce, hot sauce, etc.)	Pre**	2	51	31	11	5
	Post^	7	48	39	4	2

^n=43; ^^n=42; *n=46; **n=45

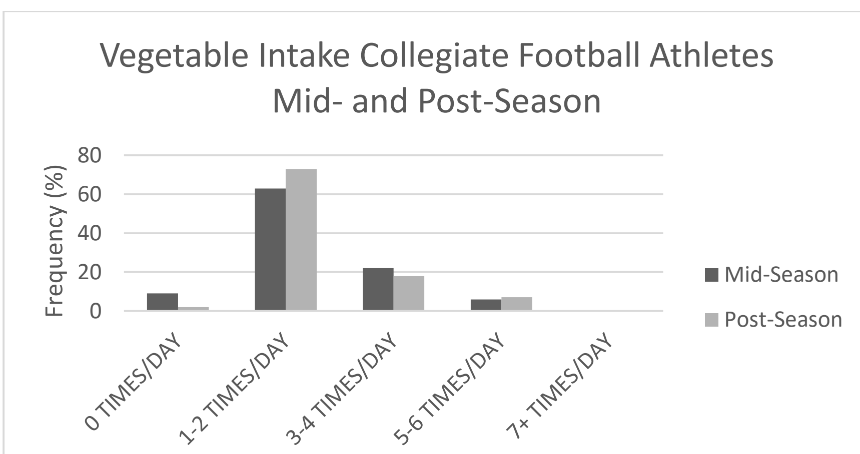
The changes in food intake form mid-season to post-season are shown in Table 9. The data were not normally distributed (N-43, Shapiro-Wilk P=0.0001) and the change in the reported number of times per week athletes ate fruit between the mid- and post-season was not significant (S=-61.5, p=0.9564).

Figure 24



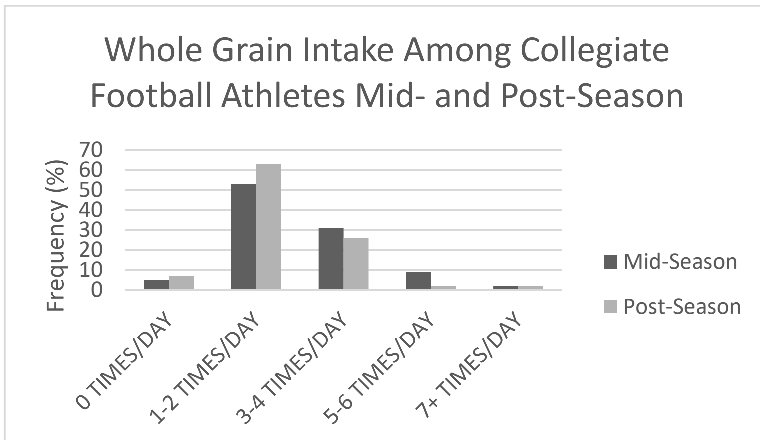
The analysis of vegetable intake changes between mid-season and post-season (Figure 25) among the study population included 43 individuals (N=43). The data were not normally distributed (Shapiro-Wilk P=0.0001) and data changes between the measurement groups were not significant (S=-2.5, p=1.000).

Figure 25



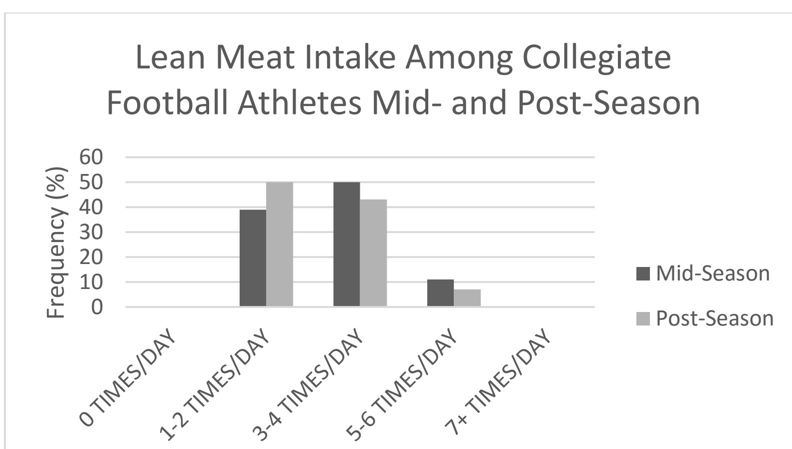
The change in the number of times per day athletes ate whole grains between the mid-season and post-season was not statistically significant (S=-25.5, p=0.3060). The data was not distributed normally (Shapiro-Wilk P=0.0002).

Figure 26



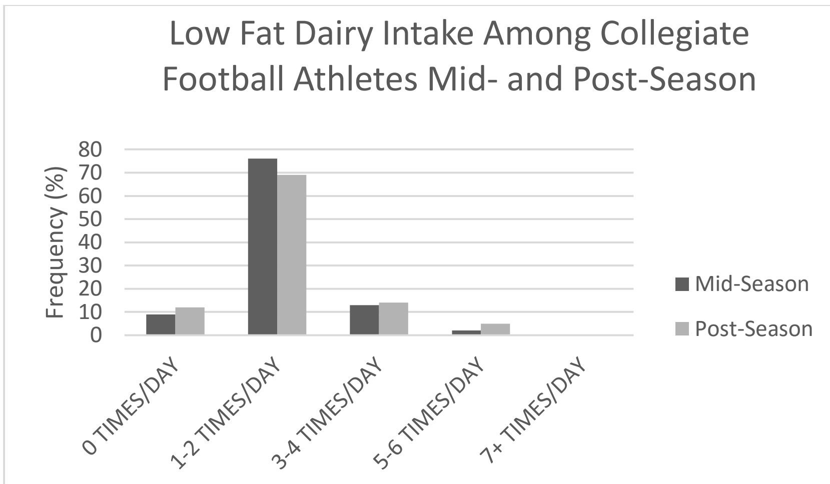
The examination of lean mean intake (Figure 27) included 43 study participants (N=43). The change between the mid-season and post-season intake measurement data was not normally distributed (Shapiro-Wilk P=0.0001) nor was the change significant (S=-34.5, p=0.1943).

Figure 27



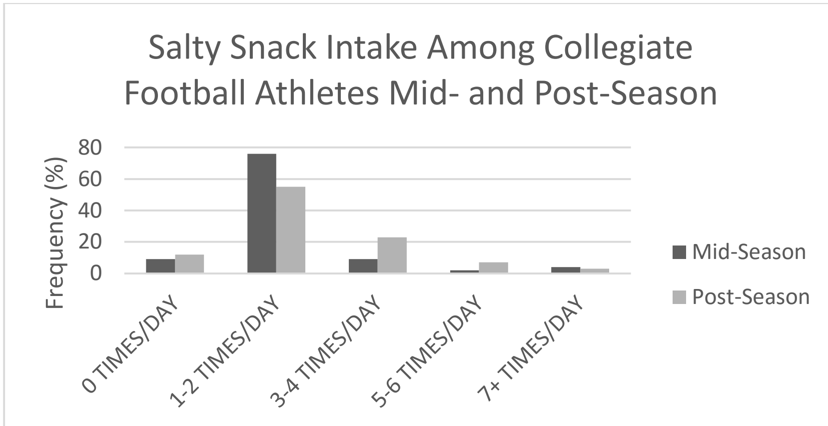
The low fat dairy (Figure 28) intake analysis included 48 study participants (N=48). The change between the mid-season and post-season intake was statistically significant (S=175.5, p=0.0001). The data was not normally distributed (Shapiro-Wilk P=0.0001).

Figure 28



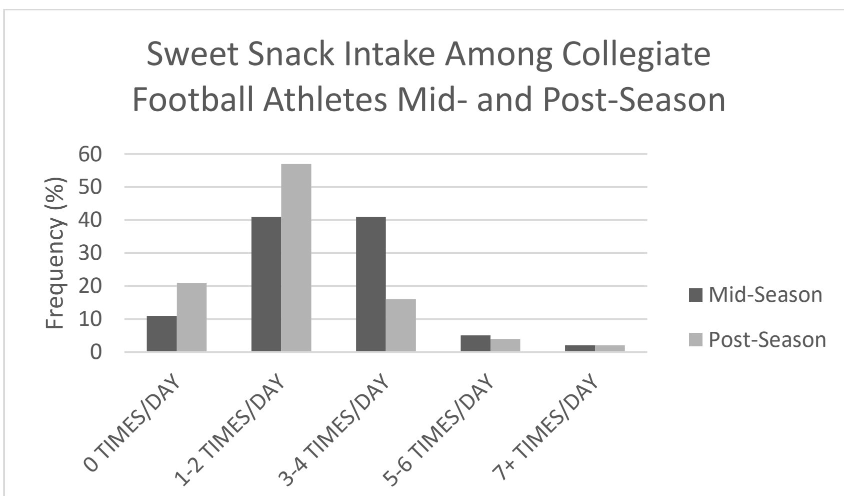
The examination of salty snack intake between mid-season and post-season measurements (Figure 29) included 42 study participants (N=42), with data that was not normally distributed (Shapiro-Wilk P=0.0001). The change did not show to be significant (S=-14.5, p=0.5920).

Figure 29



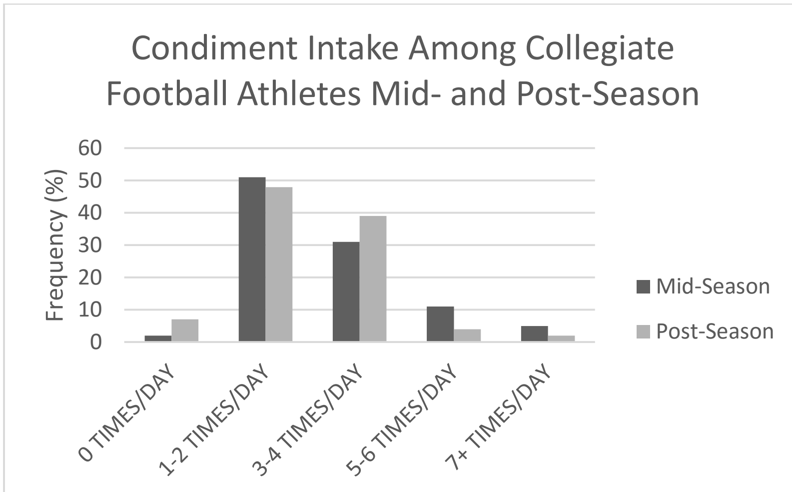
The analysis on sweet snack intake (Figure 30) included 41 study participants (N=41).The changes between the mid-season and post-season measurements showed no significant change (S=-83, p=0.0067). The data was not normally distributed (Shapiro-Wilk P=0.0002).

Figure 30



Condiment intake (Figure 31) examined 42 study participants (N=42) input. The change between the mid-season and post-season measurements were not presented in a normal distribution (Shapiro-Wilk P=0.0001) nor was the change significant (S=-36.5, p=0.2057).

Figure 31



Dining Choices

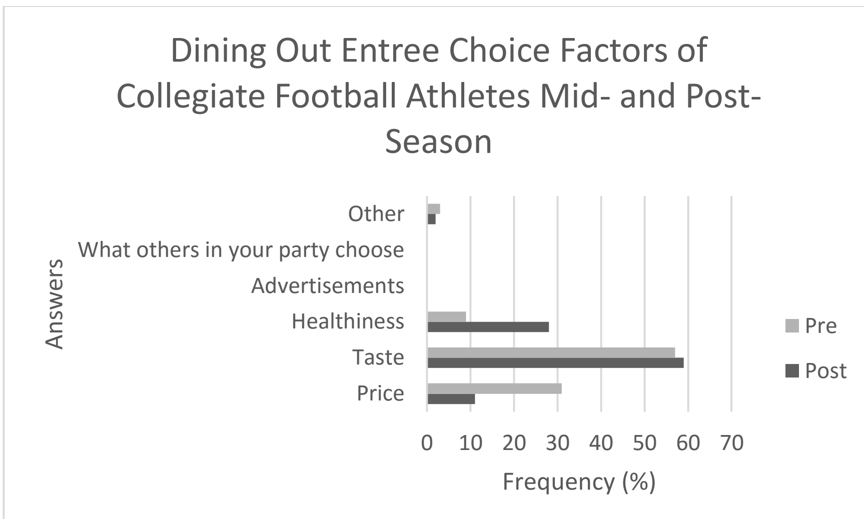
Changes in entrée factors when dining out is shown in Table 10 and Figure 32. The change in price being the primary factor of entrée choices between the mid-season and post-season measurement was -20%. Taste as the primary factor of meal choice between the mid-season and post-season measurement was 2%. Healthiness as the primary factor of meal choices between the mid-season and post-season measurement changed by 19%. Advertisements and what others in your party chose as the primary factor of meal choices between the mid-season and post-season measurement changed by 0%. The other category as the primary factor of meal choices between the mid-season and post-season measurement change -1%.

Table 10

Factors in Entrée Choice in Collegiate Football Players Pre- and Post-Educational Tool

	Pre Percentages (n=46)	Post Percentages (n=42)
Price	31	11
Taste	57	59
Healthiness	9	28
Advertisements	0	0
What others in your party choose	0	0
Other	3	2

Figure 32



Physical Activity

Changes in physical activity levels are shown in Table 11. Aerobic conditioning physical activity (Figure 33) included 42 participants (N=42). The change between the mid-season and post-season measurements resulted in a mean of 0.1 times/week (SD=0.79 times/week) showing no significant change (S=12.5, p=0.4712). The data were not normally distributed (Shapiro-Wilk P=0.0001).

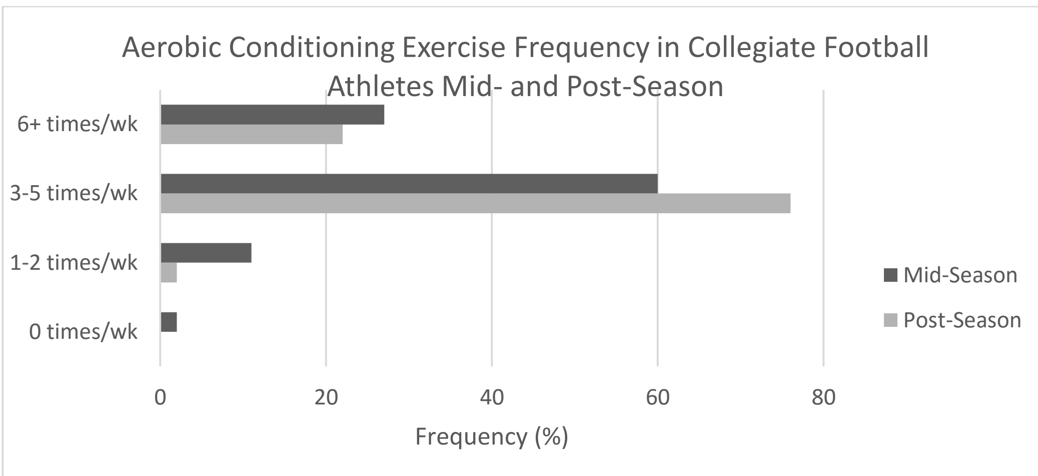
Table 11

Physical Activity Levels Mid- and Post-Season in Collegiate Football Athletes

Percentages Chosen by Participants

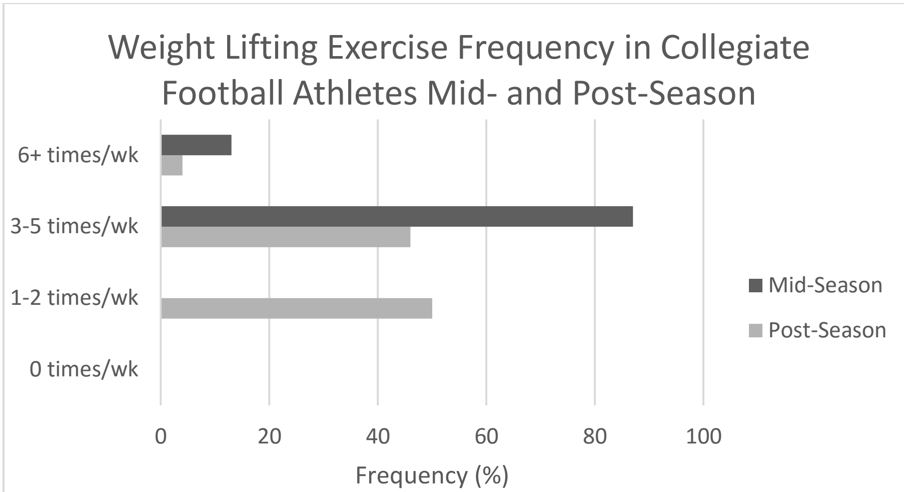
		0 times/week	1-2 times/week	3-5 times/week	6+ times/week
Lifting heavy weights	Pre n=46	0	50	46	4
	Post n=43	0	0	87	13
Conditioning exercises	Pre n=45	2	11	60	27
	Post N=43	0	2	76	22

Figure 33



Weight lifting physical activity (Figure 34) included 43 study participants (NF=43). The change between the mid-season and post-season WPA measurement was significant (S=162.5, p=0.0001) with an average change of 0.60 times/week (SD=0.54 times/week). The data distribution was not normal (Shapiro-Wilk P=0.0001).

Figure 34



Previous History of High Blood Pressure

In the examination of previous history of blood pressure among the study population, 46 total participants were analyzed (N=46). In the mid-season measurement 37% of the population (17 individuals) reported having high blood pressure. In the post-season measurement 28% (13 individuals) of the same population reported having high blood pressure.

Within the mid-season individuals who reported having high blood pressure, 65% of the individuals reported using diet to currently control it. Physical activity as a control method included 59% of the population; 76% reported being on blood pressure medication, and 71% reported other treatment.

The post-season measurement indicated 28% of those who reported having high blood pressure were using diet to control blood pressure levels. Physical activity was reported by 39% of the population as a control method currently being used, along with

22% claiming medication was being used. 11% of the population note using other methods to control blood pressure levels.

Stress Levels

In analyzing possible stress levels, 45 individuals participated (N=45) in the mid-season questionnaire measurement. 33% of the participants claim to be injured at the time of mid-season data collection. The post-season measurement included 43 participants (N=43) with 26% claiming to be injured during the post-season data collection.

Sleeping patterns analyzed included 46 study participants (N=46) during the mid-season measurement. Of the population 20% reported getting 8-10 hours of sleep per night, 72% reported getting 6-8 hours of sleep per night, 8% reported getting 4-6 hours or sleep per night, and 0% claimed getting less than 4 hours of sleep per night.

Sleeping patterns assessed in the post-season data collection included 43 participants (N=43). In the assessment 18% claimed to be getting 8-10 hours of sleep per night, 69% claimed getting 6-8 hours of sleep per night, 11% claimed to be getting 4-6 hours of sleep per night, and 2% claimed to be getting less than 4 hours of sleep per night.

Educational Tool Participation

When asked if individuals in the post-season study read the educational tool provided, 35% of the 43 participants (N=43) reported they had reviewed the educational tool. The remaining 65% claimed they did not read the educational tool.

CHAPTER FIVE

DISCUSSION:

The most popular sport among adolescents in the US is football and as a result over a quarter of the athletes in the NCAA participate in football.[10,11] Studies have shown hypertension, and premature cardiovascular mortality amongst professional football players.[5,12] The pathophysiological changes may be caused by particular behaviors that are often associated with higher level football athletes including intense resistance training and lack of aerobic exercise, diets that are high in fat and calorie dense, along with weight gain.[13,6] Blood pressure has been shown to be responsive to dietary intake, physical activity levels, and medications.[1,2,3]

In our study, which measured the change in blood pressure throughout a single season of participation, the results indicated no significant changes pre- and mid-season. The change in blood pressure measurements taken from the pre-season pre-participation physical and the mid-season measurement showed no significant change ($p=0.9224$). Although the pre-season measurements were taken by members of the sports medicine team other than the individual conducting the blood pressure measurements mid- and post-season, the lack of significant change provides reassurance regarding the reliability of the pre-season blood pressure measurements and of the training of the staff for the athletic team. The average change was an increase of systolic blood pressure of 0.17 mmHg (SD=11.91 mmHg) and a decrease in diastolic blood pressure of 1.3 mmHg (SD=10.6 mmHg). Interestingly, there was a significant change ($p=0.0007$) in blood pressure between the mid-season measurement and post-season measurement. An average decrease in systolic blood pressure of 6.7 mmHg (SD=12.3 mmHg) occurred with an average diastolic blood pressure decrease of 1.6 mmHg (SD=8.7 mmHg). Although the decrease in diastolic blood pressure was not significant, the change in systolic blood pressure was. There appeared to be an overall decrease in both systolic and diastolic blood pressure, which one might have expected due to the increase in resistance training increase in blood pressure awareness gained from the educational tool.

There was not a significant change in the general blood pressure knowledge, nor the causes of high blood pressure. The individuals who claimed to have reviewed the educational tool showed no sign of increase in knowledge either. This should be considered when performing another study with this population.

The change in the sources from which the athletes obtain their meals (dietary establishments) had very little significant change. There was a significant increase in the amount of home prepared pre-packaged meals (HPP), with an average increase of 0.5 times/week, which may have contributed to the decrease in blood pressure due to the decrease in sodium intake.[1] There was also an increase in the amount of meals taken in from the weight room snack bar (WFW). An average increase of 0.5 times/week was shown as well. The increase may be due to the weight room providing meals (i.e. sandwiches, wraps, burritos, etc.) for athletes to take with them during the spring semester. The meals are chosen by the Registered Dietician for the Clemson University Athletics Programs. The items are typically healthier than those they may have been consuming otherwise. There was a decrease in the number of meals skipped (SM), along with the meals consumed at the PAW cafeteria (WP). The PAW is the cafeteria where the athletes typically eat, located in the Clemson University football facility. The average decrease in skipped meals was 0.35 times/week. The average PAW intake showed an average decrease of 0.7 times/week. The decrease in intake from the PAW may contribute to the decrease in blood pressure. The food served in at the PAW is provided from a food service vendor in which the food is frozen or canned prior to serving. The food is served in a buffet style, allowing the athletes to eat as much of any item as desired. The decrease in food intake may be a factor in the decrease in blood pressure, along with the decrease in sodium (salt) that is often used to flavor and/or preserve ready-to-eat foods.[1] Further research should be performed on the nutritional content of the food served at the athletics cafeteria and changes in blood pressure due to meals being mandatory to the team.

Food intake was also examined in the dietary component of the questionnaire. There appeared to be an overall decrease in intake of all of the food categories (Fruits, Whole Grains, Lean Meats, Salty Snack, Sweet Snack and Condiment). Only significant changes took place in the Sweet Snack (SWS) category. There was an average decrease in sweet snack intake by 0.37 times/day, which could lead to a decrease in total calorie intake. A significant increase was shown in low fat dairy (LFD) intake with an average increase of 0.54 times/day. There was no change found in vegetable (V) intake.

When examining the physical activity responses of the athletes, the only significant change reported in physical activity level was an average increase in weight lifting (WPA) of 0.6 times/week. The increase further supports previous evidence that weight lifting is an effective way of lowering blood pressure through exercise.[2] The increase in resistance training may have contributed to the decrease in both systolic and diastolic blood pressures. There was also an increase in aerobic cardiovascular training, yet not a large enough change to be considered statistically significant.

When asked what factors went most into deciding meal choice when dining out there was reported to be an increase in the consideration of the healthiness of the food being the primary factor in entrée decision by 19% and a decrease in price as the primary factor by 20%. The other categories (taste, advertisements, other orders in the party, other) showed little or no change between the mid-season and post-season measurements. The increase in health consciousness could be a result of becoming more aware of healthy eating choices from the questionnaire or educational tool.

When previous history of high blood pressure was assessed, there showed to be a variation between the post-season and mid-season measurements. There was a change of 9% among reported high blood pressure history. When asked how the individuals are currently managing their blood pressure, the most common method in the mid-season measurement was medication, followed by diet and physical activity. The post-season measurement provided physical activity being the most common method, with diet being second and then medication.

Injury could play a role in blood pressure decrease. During the mid-season measurement 33% of the participants reported being currently injured. When the post-season measurement was taken, the number of injured participants dropped to 26%. The drop is likely due to no longer being in season and practicing. In regards to stress levels, sleep patterns were also assessed. There showed to be an overall decrease in the amount of sleep obtained on a nightly basis from the mid-season measurement to the post-season measurement. Class loads being heavier in the off-season, thus leading to more homework and study time for the individuals or time taken for more recreational activities due to no longer having training taking as much of their time may be a factor in the decrease of sleep.

When the blood pressures of the athletes were assessed and placed into normal, pre-hypertensive, and hypertensive categories, there was an increased amount of individuals in the pre-hypertensive and hypertensive ranges. Although there was a decrease from the mid-season to post-season measurements, a majority of the individuals still showed signs of hypertension and pre-hypertension.

Limitations:

One potential limitation of the study includes is the researchers not being involved in the pre-season blood pressure measurement. Different individuals taking blood pressure measurement occurred due to time being limited in the study. The blood pressure taken in the pre-season, taken from the pre-participation physical was only taken once, while all the other measurements were taken twice and averaged. The decrease in blood pressure between the pre-season measurement and the mid-season measurement was much smaller than the mid-season to post-season measurement. Another limitation of the study was the lack of height and weight taken at the mid-season and post-season measurements. When gaining permission to use the athletic training room facility, concerns with the height and weight measurements taking too much of the athlete's time during the season were expressed by the Clemson University Sports Medicine staff. The medical staff required the height and weight measurement portion be omitted. The Clemson University Football Strength and Conditioning staff was asked for weight measurements, as they take them weekly, but they unfortunately did not wish to provide the requested information.

Another limitation to be considered is the self-reporting nature of the questionnaire. During the post-season measurement, some athletes who reported on the questionnaire that they had read the educational tool previously provided, verbally stated that they had not reviewed the educational handout when turning in the finished questionnaire. Those who had stated they did not actually review the educational tool and what the participant had marked is what was used in the data analysis. In addition to this, there were complaints about the questionnaire being too long by some of the participants that may have led them to not fully consider the answers they provided. The questionnaire took 5-10 minutes for the pilot study, along with the research performed. With the pilot study, the individuals did not complain about the length of the questionnaire. The population used within the study is prone to complaining about performing additional tasks that are not typically included in their normal daily lives (personal observation).

Another factor that should be considered is the football program success of the season. Due to participating in the post-season national championship game, the time between measurements was stretched out further than most collegiate level football programs would have been. Further, the final game the athletes participated in resulted in a loss, which may affect the stress levels of the individuals.

Serving size was not considered in the dietary intake portion. The intake that was measured was frequency rather than servings. This should be taken into consideration when further research is performed.

Educational Tool Participants:

The individual's that reported reading the educational tool provided were analyzed again separately from those claiming they did not. The results differed very little from the combined group showing no significant changes in the questionnaire assessment.

Further Research:

Further research should be performed on whether there is a direct relationship between consumption of meals at the athletics cafeteria and changes in blood pressure levels due to the frequency in which meals are eaten in the location, often stated as mandatory. Ideally, a study with more measurement periods could show be of benefit to properly track changes throughout a season, however, access to the athletes during the season proved difficult and could account for the lack of studies in the literature on collegiate athletes during their season. There is more room for research in further developing and testing any educational tool that will increase the blood pressure knowledge of the collegiate football population. A possible alternative to the handout we provided may include an educational component that is more interactive or based on a computer. The athletes stated after the study that they are not prone to checking their email, although they stated email as their preferred way to receive information. An educational program provided on a computer may be beneficial due to the increase in electronic use and knowledge in the collegiate football study population.

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CONCLUSION:

The study performed showed no significant change in knowledge scores between the pre-season and mid-season questionnaire measurements. The lack of knowledge change shows an educational tool designed in the form of a handout may not be effective in the collegiate football population. Interestingly, however, although there was little change shown in the knowledge score and no significant change between the pre-season and mid-season blood pressure measurements, there was a decrease in blood pressure noted between the mid-season and post-season measurements during the study time period. The decrease in blood pressure could be a result of many components such as an increase of intake of low fat dairy products and a decrease of sweet snack consumption. The blood pressure change could also be a result of an increase in home prepared meals combined with a decrease in meals skipped and meals consumed at the PAW. Athletes reported that they were considering healthier food options in the post study results. Physical activity levels may also play a role in the blood pressure decrease due to an increase of weight lifting exercise being shown. Increased awareness of one's blood pressure as a function of participating in the study is also a factor to be considered. There is room for further research on the topic.

APPENDICES

APPENDIX A: QUESTIONNAIRE FOR PARTICIPANTS OF THE STUDY

The questionnaire was used to measure blood pressure knowledge, dietary intake, physical activity, and stress levels in the study participants.

Athlete Identifier: ____________________________ Date: __________________________

<u>Blood Pressure Knowledge</u>

Are the following statements true or false? **Please circle the most correct answer.**

Most people can tell when their blood pressure is high because they feel bad.	True	False
Young adults do NOT have high blood pressure.	True	False
Alcohol consumption lowers blood pressure.	True	False
Lowering salt intake has been shown to be beneficial for lowering blood pressure.	True	False
When you lift heavy weights, your blood pressure increases.	True	False
Eating more fruits, vegetables, whole grains and low fat dairy can lower your blood pressure.	True	False
When you are active, it is <u>normal</u> for your blood pressure to increase, but once the activity stops your blood pressure will return to your normal baseline range.	True	False
It is NOT normal for blood pressure to change when you sleep, wake up, are excited or are nervous.	True	False

<u>**Causes of 'High Blood Pressure'** Knowledge</u>

Are the following statements true or false? **Please circle the most correct answer.**

If your mother or father have high blood pressure, your chance of also having high blood pressure is high.	True	False
Cardiovascular/aerobic exercise increases your blood pressure.	True	False
Being overweight or obese can lead to high blood pressure.	True	False
Drinking excess amounts of alcohol will NOT increase the risk for high blood pressure.	True	False
High dietary salt intake always causes high blood pressure.	True	False
Lack of physical activity can cause high blood pressure.	True	False
Stress can raise your risk for high blood pressure.	True	False
Lifting heavy weights can temporarily increase blood pressure but does NOT <u>cause</u> lasting high blood pressure (also known as hypertension).	True	False

What would you define as a <u>normal</u> blood pressure reading? Blood pressure units are in mmHg.

Please circle the most correct answer **for SBP <u>and</u> for DBP –** circle only one answer for SBP and one answer for DBP.

Systolic Blood Pressure (SBP)	150	140	130	120	110
Diastolic Blood Pressure (DBP)	100	90	80	70	60

Diet

How many **meals a week** do you eat at the following places? **Please check the most correct answer.**

	0/wk	1-2 meals/wk	3-5 meals/wk	6-8 meals/wk	9+ times/wk
On campus Cafeteria					
On campus food establishment other than a Cafeteria					
Fast Food					
Restaurant					
Home (self-prepared meal)					
Home (prepackaged/frozen meal)					
West End Zone (PAW)					
West End Zone weight room					
Skip Meal					

How many **times per day** do you eat the following? **Please check the most correct answer.**

	0 times/day	1-2 times/day	3-4 times/day	5-6 times/day	7+ times/day
Fruit					
Vegetables					
Whole Grains					
Lean Meats					
Low fat dairy					
Salty Snacks					
Sweet Snacks					
Condiments (ketchup, mustard, BBQ Sauce, hot sauce, etc.)					

When dining out, which <u>one</u> of the following do you consider the most when choosing your entrée?

a. Price
b. Taste
c. Healthiness
d. Advertisements
e. What others in your party choose
f. Other: ____ ____________

Physical Activity:

How many times a week do you partake in the following: (check one)

	0 times/week	1-2 times/week	3-5 times/week	6+ times/week

Lifting heavy weights				
Conditioning exercises				

What position do you play on the team?
____

Have you ever been told you have high blood pressure? Yes No

a. If yes, what methods are you currently using to control it? Circle **ALL** that apply.
    a. Diet
    b. Physical Activity
    c. Medication
    d. Other ____

Have you been injured recently?	Yes		No	
If yes, how long have you been injured?				
How many hours of sleep do you typically get a night? (check one)	8-10 hours	6-8 hours	4-6 hours	Less than 4 hours

<u>Post Study Questions: (please circle your answer)</u>

What was your preferred method to receive information on blood pressure? (select only one)

a. E-mail
b. Hard copy
c. No preference

APPENDIX B: EDUCATIONAL HAND OUT

The educational handout given to provide information on blood pressure to the study participants.

YOU are in Control

Blood Pressure Facts

- Blood pressure (BP) is the force of your blood pushing against your arteries. **Normal blood pressure for adults is 120/80mmHg or less.**
- **Many things can cause your blood pressure to increase or decrease.**
  - For example, when you are active, it is normal for your blood pressure to increase, but when you stop the activity (such as lifting heavy weights OR participating in cardiovascular/aerobic exercise) your blood pressure will then return to your normal baseline range.
  - When you sleep, wake up, are excited or are nervous it is normal for your blood pressure to change.
  - Blood pressure tends to increase as people age, but young adults can develop high blood pressure.
  - Increases in blood pressure are called "Silent" as most people do not feel it when their blood pressure rises.

Some things can **increase your risk for developing High Blood Pressure**

(BP that stays elevated over time and is known as Hypertension; defined as a sustained BP of 140/90mmHg or higher). These include:

- Lack of physical activity
- Being overweight or obese (being an unhealthy body weight)
- Drinking excess amounts of alcohol
- High dietary salt (sodium) intake, especially in some people (who are sodium sensitive) – but not all people.
- Stress – especially if it is for long periods of time

You can control **ALL** of these!!

Some things can **decrease your risk for developing High Blood Pressure**

(OR lower your blood pressure if it is high)

These include:

- **Be physically active**
- Practice **Heart-Healthy Eating**
    - Eat more fruits & vegetables, whole grains, beans & peas, fish high in omega-3 fatty acids & fat-free/low fat dairy products
    - Eat fewer sugary foods & beverages, red meat, & saturated & trans fats
- **Maintain a healthy weight**
- **Limit alcohol intake**
- **Limit dietary salt** (sodium) intake (lower salt intake has been shown to be beneficial for lowering blood pressure)
- **Mange Your Stress**
    - physical activity, music, focusing on calming thoughts, meditating, & yoga/tai chi have shown positive effects

Remember, you are in control!

There are risk factors for High Blood Pressure you cannot control

- Family history – if your family has a history of high blood pressure you are at increased risk.
- Gender – men are at higher risk for High Blood Pressure until age 55.
- Race/ethnicity – some people are at higher risk due to their race or ethnicity.
- Age – older individuals are at higher risk.

As there are risk factors for high blood pressure that you cannot control, it is important to control the risk factors that you can.